## ON THE COVER

IN SPITE of Canada's wealth of hydroelectric power, the crude windmill pictured on the cover remains in service, turning a modern circular saw to produce a small quantity of lumber each day. The mill is located at a tourist-cabin camp near Cap de la Madeleine, close to the St. Lawrence River on the Gaspe Peninsula, Province of Quebec.

●

## IN THIS ISSUE

MOST interstate natural-gas transmission lines carry fuel from the Southwest to the industrial and populous centers of the Midwest and East. Reversing this trend, El Paso Natural Gas Company, in conjunction with two California utilities, delivers it to the two largest Pacific Coast cities, Los Angeles and San Francisco. In addition, El Paso supplies gas to many communities in Texas, New Mexico, Arizona, and northern Mexico. Once it was able to get all the gas it needed from the oil fields of the Permian Basin, but as sales increased it ran a line northward to the Hugoton gas field in the Texas Panhandle. More recently, it reached farther north to tap the San Juan Basin fields of northern New Mexico and southern Colorado. All told, it now operates 5700 miles of line, constituting one of the nation's largest natural-gas networks. The story of El Paso's activities is told in our leading article.

●

A MAN with four or five hands could do a lot of work, but it is useless to think about it because Nature isn't going to change the human anatomy. Fortunately, the brain can think up ways to accomplish the same result and save a lot of manual labor to boot. One of the latest ideas is to combine from two to eight pneumatic nut runners and operate them as a single tool. Such machines are improving the quality of the work done on assembly lines and saving a lot of time as well. Page 235.

●

BECAUSE of the character of the work they do, airplane factories use air power extensively. For example, it takes nearly 6000 cfm of compressor capacity and 20 miles of air lines to serve the needs of a single plant on the Pacific Coast. Page 239.

●

WITH the nation girding for defense, lead and zinc are important metals. More of them will come from the historic Colorado camp of Leadville when the deep drainage tunnel being driven there by the U. S. Bureau of Mines is completed. Work on it was begun during the last war, suspended when funds gave out, and resumed in recent months. Water sufficient to supply a city of 25,000 persons is already flowing from the area perforated by the old mine workings.

●

## CORRECTION

IN THE article, *Flame Spraying Plastics*, pages 209-10, August issue, it was stated that W. B. DeLong and E. V. Peterson, who developed special equipment used in the process, are with American Agile Corporation, of Cleveland, Ohio. Actually, both are with E. I. du Pont de Nemours & Company, Wilmington, Del.


# Compressed Air Magazine



COPYRIGHT 1951 BY COMPRESSED AIR MAGAZINE COMPANY



VOLUME 56 **September, 1951** NUMBER 9

G. W. MORRISON, *Publisher*
C. H. VIVIAN, *Editor* J. W. YOUNG, *Director of Advertising*
ANNA M. HOFFMANN, *Associate Editor* J. J. KATARBA, *Business Mgr.*
J. C. PIERCE, *Assistant Editor*
A. W. LOOMIS, *Assistant Editor* JOSEPH C. DILTS, *Advertising Mgr.*
D. Y. MARSHALL, *Europe*, 243 Upper Thames St., London, E. C. 4.
F. A. MCLEAN, *Canada*, New Birks Building, Montreal, Quebec.


## EDITORIAL CONTENTS


5700 Miles of Controlled Energy—*J. C. Pierce* ..... 228
Running Two to Eight Nuts at a Time—*C. H. Vivian* ..... 235
Twenty Miles of Air Lines ..... 239
Leadville Drainage Tunnel ..... 241
More Power at Niagara ..... 243
Fairless Steel Works Rises ..... 244
Editorials—Stockpiling—Flooded Areas Rebound—Exeunt Highgraders ..... 246
This and That ..... 247
Crusher Removes Carbon from Cloth ..... 249
Nickel Company Forsakes Open Pits ..... 249
Ropes Serviced in Motion ..... 249
Industrial Notes ..... 250
Books and Industrial Literature ..... 254


## ADVERTISING CONTENTS


Adams Co., Inc., R. P. ..... 29
Air-Maze Corporation ..... 38
Bethlehem Steel Company ..... 13
Combustion Engineering-Superheater, Inc. ..... 30
Compressed Air Magazine Co. ..... 34
Cook Mfg. Co., Inc., C. Lee ..... 28
Coppus Engineering Corporation 2nd Cover
Crucible Steel Co. of America ..... 18
Cuno Engineering Corporation ..... 14
Dayton Rubber Company, The ..... 6, 7
Dollinger Corporation ..... 3
Donaldson Company, Inc. ..... 24
du Pont de Nemours & Co., Inc., E. I. 16
Eimco Corporation, The ..... 9
Elliott Company ..... 35
Fluor Corporation, Ltd., The ..... 27
Galland-Henning Mfg. Co. ..... 23
Goodrich Company, The B. F. ..... 26
Hansen Manufacturing Co., The ..... 32
Hunt & Son, Inc., C. B. ..... 19
Ingersoll-Rand Company ..... 4, 15, 31 3rd Cover
Johnson Corporation, The ..... 37
Koppers Company ..... 5
Maxim Silencer Co., The ..... 17
Naylor Pipe Company ..... 20
New Jersey Meter Company ..... 34
Niagara Blower Company ..... 21
Norton Company ..... 11
Nugent & Co., Inc., Wm. W. ..... 37
Rucker Company, The ..... 38
Sarco Company, Inc. ..... 10
Sauerman Bros., Inc. ..... 34
Square D Company ..... 38
Terry Steam Turbine Co., The ..... 33
Texas Company ..... Back Cover
Timken Roller Bearing Co., The ..... 36
Toledo Pipe Threading Machine Co., The ..... 12
Victaulic Co. of America ..... 22
Vogt Machine Company, Henry ..... 25
Walworth Company ..... 8
Wisconsin Motor Corporation ..... 37
Westinghouse Electric Corp. ..... 39



**A monthly publication devoted to the many fields of endeavor in which compressed air serves useful purposes. Founded in 1896.**

**ABC Member Controlled Circulation Audit**

Published by Compressed Air Magazine Co., G. W. MORRISON, *President;* C. H. VIVIAN, *Vice-President;* J. W. YOUNG, *Secretary-Treasurer.*
Editorial, advertising, and publication offices, Phillipsburg, N. J.
New York City Office, 11 Broadway. L. H. GEYER, *Representative.*
Annual subscription: U.S., $3.00; foreign, $3.50. Single copies, 35 cents.
COMPRESSED AIR MAGAZINE is on file in many libraries and is indexed in Industrial Arts Index and in Engineering Index.

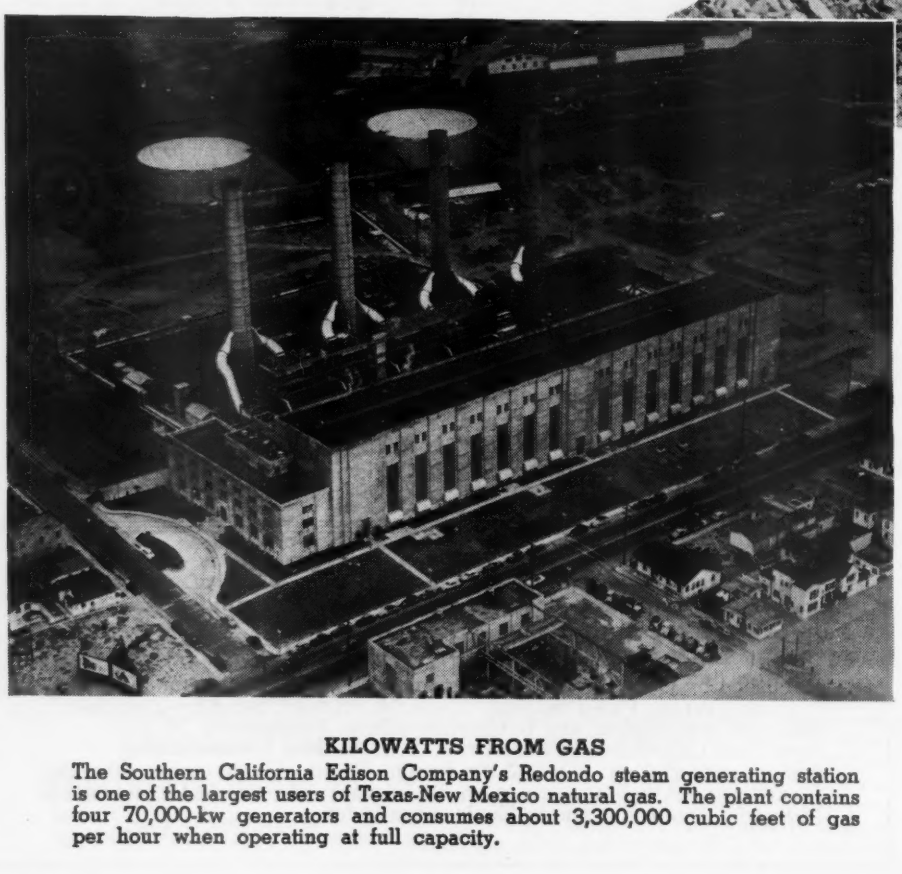
**INDIAN TRADING POST**

An El Paso Natural Gas Company plane at the Dilkon (Arizona) Trading Post 50 miles from a highway in the San Juan Basin country on the Navajo Indian Reservation. At posts like this the Navajo trades his sheep, wool, blankets and silverwork for the white man's goods that he needs. Dilkon means "smooth hill." Unlike the table-top protruberances and buttes with near-vertical sides so common on the reservation, the hill in the background served as an important landmark for the early Navajos.

# 5700 Miles of Controlled Energy

## El Paso Natural Gas Company Operates a Far-flung Pipe-line System

**J. C. Pierce**

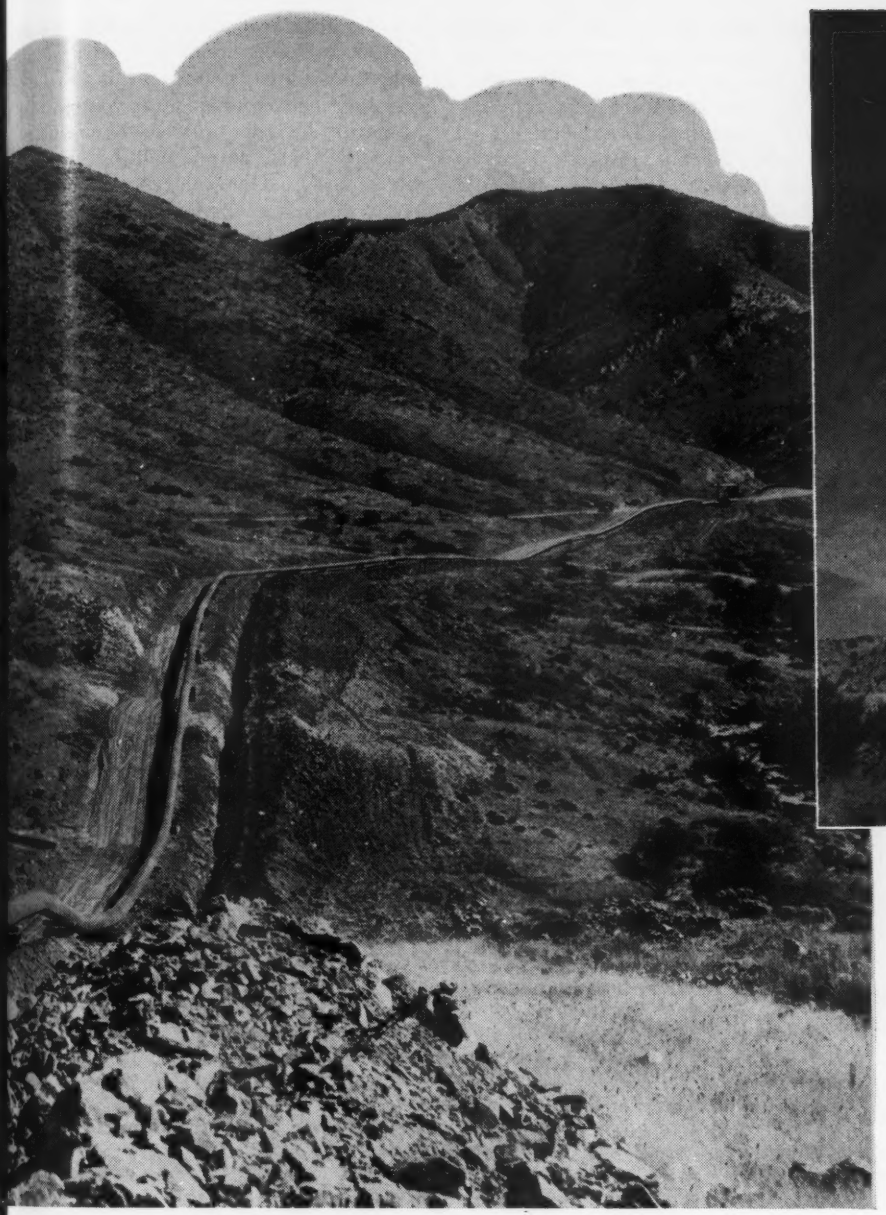


**KILOWATTS FROM GAS**

The Southern California Edison Company's Redondo steam generating station is one of the largest users of Texas-New Mexico natural gas. The plant contains four 70,000-kw generators and consumes about 3,300,000 cubic feet of gas per hour when operating at full capacity.

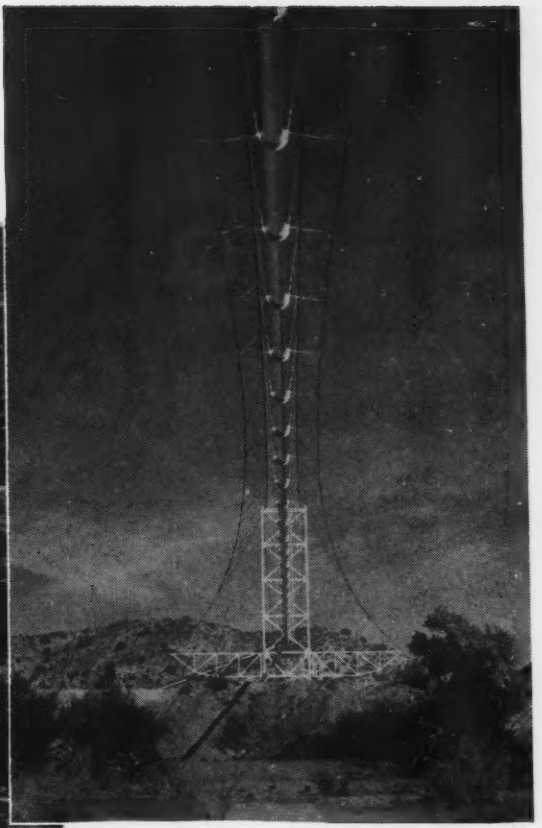
IT HAS often been said that the relative strength of a nation depends, among a host of other factors, upon its fuel supply. Certainly a country's sources of energy are all-important to its existence, and major developments in directing natural fuels from nature's storehouses to industries and homes are noteworthy. Harnessing a waste oil-well product to the wheels of industry and making it available so as to add to the comfort and convenience of homes throughout a vast area is the business of the El Paso Natural Gas Company.

Perhaps even the most optimistic dreams of the founders of El Paso Natural in the late 1920's failed to forecast the expanse of that company's present transmission network. A main-line pipe system ranging from 16 to 31 inches in diameter and extending from Dumas, Tex., to San Francisco, Calif., has grown out of the original 208 miles of 16-inch line connecting an oil field at Jal, in the southeastern corner of New Mexico,



**TORTUOUS TUBE OF STEEL**

A line constructed across the Apache Pass in Arizona. The pipe has been welded and is ready for priming (sometimes referred to as doping) and wrapping for corrosion resistance. That done, it will be carefully lowered into the ditch and covered with backfill.



**BRIDGING A DRY RIVER**

More than 3 miles of bridges, built at a cost of $4,000,000, carry the line over streams, some of which are dry or mere trickles except when occasional floods convert them into raging torrents. One of these is the Bill Williams River, shown here crossed by one of the system's fourteen suspension bridges. The 980-foot-long structure supports 30-inch piping.

with a few industrial installations and the then 100,000 people of El Paso, Tex. That initial investment of $6,000,000 in 1929 has mounted to $280,000,000 and represents 5700 miles of main and lateral pipe lines, treating and compressing plants and other assets. Three applications now before the Federal Power Commission provide for an expansion program that would raise the capital investment to $372,000,000, an increase of $92,000,000. Gas deliveries in 1950 totaled 237,348,210,000 cubic feet as against 5,406,672,000 in 1930.

Gas gathering extends from the original oil field at Jal through adjoining fields in the southeastern corner of New Mexico to west-central Texas—all known as the Permian Basin—and to the Texas Panhandle, or Hugoton Fields. Recently it has reached beyond into the San Juan Basin comprising a part of northwestern New Mexico and of southwestern Colorado.

Serving an area with a population of twelve million in west Texas, New Mexico, Arizona, northern Mexico and California, the El Paso Company does not retail gas but sells only to public utilities, either for distribution or for generating power, or to large industrial consumers who can take delivery outside of city limits. Breaking down its 1950 gross operating revenue of $39,952,024 we find that public utilities purchased 77.5 percent of the gas for resale for domestic, commercial and industrial use and for developing electricity; copper mines, smelters and refiners, 16.8 percent; other industrial customers, 1.8 percent; natural gasoline and by-products represent 3.2 percent and miscellaneous applications, 0.7 percent.

About half of the nation's copper production and more than 90 percent of its potash come from mines and plants which burn gas from the company's Southern Line. The Los Angeles industrial zone, served by two California distributors taking gas from the Southern Line terminus at the Arizona border, ranks among the country's top five city areas in value of products manufactured. The San Francisco industrial section, a big empire that is becoming more and more dependent upon Texas-New Mexico gaseous fuel, is supplied by the connected Southern and Northern lines, the gas being delivered by California's Pacific Gas & Electric Company.

It is estimated that three-fifths of all the natural gas used in the area covered by El Paso Natural Gas Company's system is supplied by it. Measured in terms of fuel value (Btu's), the amount consumed is severalfold greater than all the other energy available. Since the gas is delivered at about one-third the cost of any other fuel, the section involved is enjoying a saving

in industrial and home fuel estimated at $70 to $100 million a year.

El Paso Natural's contribution to the economic welfare of the Southwest and West Coast by reason of its gathering, treatment and transmission of natural gas is pinnacled by the contribution it makes to the nation in conserving and utilizing a natural resource. The gas from the Permian Basin and the Hugoton Fields is predominantly residue gas —a "sour, acid" by-product that is obtained in the production of oil and natural gasoline and that was almost entirely "flared" (burned at the well head to prevent air pollution) prior to 1942-43 owing to lack of a market. This "waste" gas, together with any dry or natural gas used, is now treated by the glycol-amine process to remove hydrogen sulphide, carbon dioxide and water. Thus converted into a superb 1100-Btu fuel, it is compressed for its journey westward through the pipe-line system.

In 1950 almost 74 percent of the natural gas delivered to markets through the company's pipe lines was residue gas, representing some 198,432,294,000 cubic feet and being equivalent in fuel value to 33,072,000 barrels of oil. Dry gas from the natural-gas wells in the oil fields of the Permian Basin is used only to supplement the treated residue gas when the demand for the latter exceeds the supply.

Also significant from the standpoint of economies effected through the utilization of residue gas is the revenue paid the oil companies for this waste by-product by the El Paso Natural Gas Company. In 1950 it amounted to $11,800,000—a sizable contribution towards the exploration for and the development of more of the nation's oil and gas reserves.

The gathered and treated gas must be put under an initial pressure to start it through the transmission lines to markets, and it must be given pressure "boosts" at points along the route. Compressor stations are maintained at approximately 100-mile intervals on the main lines of the system to keep the daily deliveries of about 1068 million cubic feet of gas moving. The pressure at the suction (intake) side of such a plant is approximately 550 psi, and powerful compressors driven by gas engines raise it to a maximum of 830 psi, with the average discharge pressure close to that point. It has been determined through engineering data, coupled with the results of economic studies pertaining to the transmission of gas under existing conditions, that these working pressures and the 100-mile interval between stations are the most advantageous.

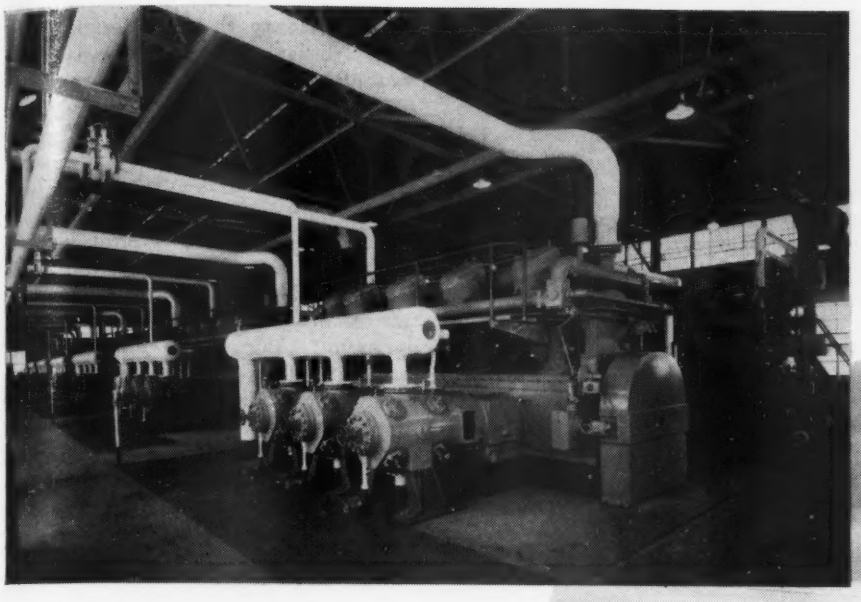
Now, however, to increase the flow through the pipe lines so as to keep up with and ahead of growing demands, the company has petitioned the Federal Power Commission for permission to build a large number of additional compressor stations, of which several are scheduled for construction this year. Exceeding in size and scope any similar installation in the natural-gas industry, some of these plants will be supplied with 5000-hp General Electric gas turbines powering Ingersoll-Rand centrifugal compressors. The plans call for the building of two between adjoining main-line reciprocating-compressor stations, leaving an interval of 33 miles instead of the present 100 miles between plants. This would add approximately 125,000 hp to the existing capacity, which is 301,680 hp.

Needless to say, in an area where water is a scarce and precious commodity, mechanical equipment requiring minimum cooling with this medium wins favor. Water is needed, however, to cool the engine-compressors and engine-generators. Furthermore, the heat added to the gas by compression is reduced in cooling towers from a temperature of around 130°F to about 90° before the gas is readmitted to the transmission lines. To meet these requirements, it has been necessary to provide 60 water wells along the system. These range in depth from 30 to 1700 feet and are generally at the station sites, but one is as much as 6 miles away from the plant it serves. These wells vary in capacity from 18 to 350 gpm, further emphasizing the short-

ADAPTED FROM THE "PETROLEUM ENGINEER"

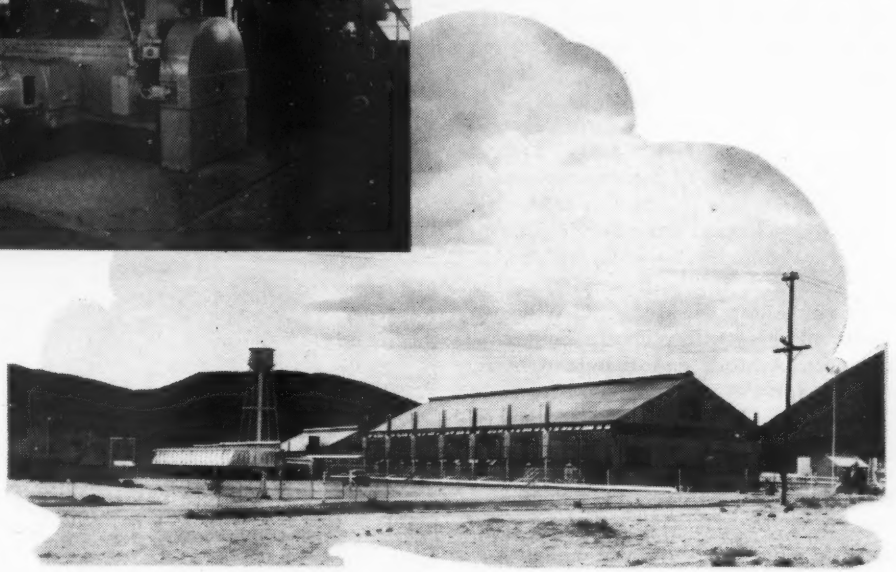
**MAP OF SYSTEM**

Solid lines show the main gathering and transmission lines of the El Paso Natural Gas Company. Broken lines represent connecting links of California pipe-line companies. The section from Needles to the San Francisco area is operated by the Pacific Gas & Electric Company, and that from Blythe to Los Angeles by both the Southern California Gas Company and the Southern Counties Gas Company of California. Laterals and customers' connecting lines of the El Paso Company are not shown. The latter's first line ran from Jal, N. Mex., to El Paso, Tex.



**GUADALUPE STATION**

Located 95 miles from El Paso and 70 miles from Carlsbad, N. Mex., this is the most isolated of all the company's compressor stations and requires a complete camp site, including a school, for its workers. The large structure below houses fourteen Ingersoll-Rand Type XVG gas engine-driven compressors. Some of the units are shown in the interior view (left). Eleven additional machines of a similar type are in another building.



age and unpredictability of the underground sources. The company prides itself on the development of a satisfactory cooling tower using atmospheric air controlled by fans to cool the gas where the water supply is inadequate.

The Southern Line from the Permian Basin pushed westward slowly in the late 1930's and early 1940's, shooting out laterals and incorporating connecting lines from large customers to serve major industries and settlements as increasing supplies of gas were assured. A branch was added at an early date to the original main line—now consisting of a 30-inch, a 26-inch, and two 16-inch lines—to provide the needs of the potash industry of Eddy County in southeastern New Mexico, and another connection built by a customer was carried northward some 90 miles to deliver gas to the town of Roswell, N. Mex., and several farming sections en route. Near El Paso, a lateral reaches northward to the famous White Sands Rocket Proving Grounds and continues on to the community of Alamogordo and the Holloman Army Air Base, which is the headquarters for the joint-military guided-missile bombing range.

Westward from El Paso, which is now a city of approximately 130,000 persons with some heavy and many light industrial plants, a connecting line that is not a part of the company's system serves Las Cruces, N. Mex., in the fertile Mesilla Valley farming region. Still farther west, another lateral extends northward to fire the smelter and the electric power plant of Kennecott Copper Corporation's Chino Mines Division at Hurley, N. Mex., and branches out to satisfy the demands of domestic consumers in nearby towns. In southern New Mexico the line divides, entering Arizona at three points to better encompass the southern half of that state.

The plants of the principal copper mining companies in Morenci, Globe, Miami, Hayden, Douglas, Bisbee, Superior and Ajo in Arizona, and south of the border in Cananea, Mexico, have long been in the system. The major Arizona cities of Tucson and Phoenix are enjoying the conveniences of natural gas from the Permian Basin, and now a branch goes down to Yuma from a point near Ehrenberg, Ariz., across the Colorado River from Blythe, Calif. At Blythe, two Southern California distributing companies—the Southern California Gas Company and the Southern Counties Gas Company of California—accept the gas for the remainder of its 1200-mile journey from Texas to Los Angeles.

The new prong of the system—The Northern Line—has its beginning in the San Juan Basin of San Juan County, New Mexico, and in the adjoining Montezuma and La Plata counties of southwestern Colorado. There are both "sweet" and "sour" gas fields in the San Juan Basin. The former requires no treatment, but represents only a small percentage of the volume of gas gathered in the area, while some of the sour gas is the most highly acid gas known to the industry and has necessitated the building of the world's largest treating plant.

Increased consumption of industrial gas in the San Francisco and other northern California areas and depletion of much of California's available natural-gas reserves prompted the $44,500,000 San Juan Project, just as similar conditions several years ago in the Los Angeles industrial region caused it to turn for gas to the Permian Basin fields. That service was begun in 1947 via the Southern Line at the rate of 125 million cubic feet daily and gradually increased to 400 million cubic feet. By tapping the tremendous gas reserves of the San Juan Basin, and by linking the southern and northern main lines with a 30-inch-diameter pipe line in western Arizona, more complete and efficient utilization of the Permian Basin flare gas can be effected and a constant flow of fuel guaranteed consumers throughout the entire system. The connection extends from a point of the Southern Line near Quartzite to Topock, where the Northern Line crosses the Colorado River into California.

Dry gas from the San Juan Basin will be used to meet any deficiencies in the supply of residue gas that may occur at brief intervals in the Permian Basin. Since residue gas is produced in connection with oil that is under allowables fixed by state regulatory agencies, the flow may not always be sufficient to meet the varying needs of distributors and consumers. The San Juan Basin will therefore act as a booster and compensate for fluctuations that otherwise might cause serious service interruptions. It is estimated that an additional twenty billion cubic feet of residue gas,

the equivalent of some 3,300,000 barrels of oil, can be drawn from the Permian Basin each year in consequence. Of the total gas distribution in 1949, residue gas accounted for more than 83 percent, and in 1950 for nearly 74 percent. The company states that this high rate of consumption will continue, and that residue gas will at no time in the future be less than 75 percent of the total annual delivery.

The 24-inch pipe line coursing for 450 miles from San Juan County, New Mexico, to Topock, Ariz., is expected to carry a peak load of 167 million cubic feet per day. According to present estimates, 150 million cubic feet will be transmitted to California and the balance will be available to users in New Mexico and in northern Arizona. In its westward march to Topock, where Pacific Gas & Electric Company will take over distribution to the San Francisco Bay area, the Northern Line has initiated service in the towns of Gallup, N. Mex., and Winslow, Holbrook, Flagstaff, Williams, Seligman, Prescott, Ashfork and Kingman, Ariz.

Although the 120-mile crossover from Quartzite to Topock was considered the most difficult section to install because of the isolation of the region, the rugged terrain, severe heat, choking dust and lack of water, the 450-mile Northern Line presented an even greater challenge to the pipe-line crews. With construction started in mid-1950, a race with time began. So that work would not come to a standstill and the line would be completed at the earliest possible date in 1951, it was necessary to finish by December the stretch east of Williams where winter conditions are severe and might halt operations. In the region west of Williams, which lies at a lower altitude, the pipe could be laid in the dead of winter.

The route of the Northern Line had to deviate from the straight line normally followed because much of the terrain was inaccessible and it involved traversing elevations ranging from 1100 feet at Topock to 7800 feet near Flagstaff. Too, National Monuments had to be avoided, and that added many miles. Starting in the high mesa lands of the San Juan and proceeding across the Painted Desert section of northern Arizona, the going was rough and continued so. Upon approaching the San Francisco Mountains of the Flagstaff-Williams area a thick ground cover of scrub cedar, oak and other foothill growth had to be arduously removed from the right-of-way. As altitude was gained in the region around Flagstaff that vegetation gave way to the towering pines of the Yavapai and Coconino National Forests and the "pipeliners" became full-fledged lumberjacks.

Emerging from the forests and descending slowly to the Colorado River Valley, other difficulties such as sharp foothills, hard rock, arid climate, dust and summer temperatures as high as 130°F had to be overcome. But fortune smiled on the workers in at least one respect: the winter of 1950-51 was unusually mild and the handicaps of blizzards, deep snows and severe cold were minimized. More than 160 miles of ditch had to be blasted in rock at an expenditure of around two million pounds of dynamite. Portable compressors and pneumatic drills played a major role in that work. Toiling under such arduous conditions and racing against time both men and machines were put to a severe test.

An obstacle was encountered in the Flagstaff section that stood out in sharp contrast to the 160 miles of rock work.

**PROTECTIVE WRAPPING**

Here a 24-inch line on the northern San Juan branch of the system is undergoing doping and wrapping. As the wrapping machine moves along, the Navajo at the end of the pole on the left keeps it from turning off the pipe. The corrosion-resisting coating, which is applied at a boiling temperature ahead of wrapping, is responsible for the cloud of steam.

•

**STATION GENERATORS**

Interior of the electric generator station at the Fullerton, Tex., field plant that treats and dehydrates residue gas received from a nearby Phillips Petroleum Company natural-gasoline refinery. Four Ingersoll-Rand 370-hp gas engines, direct connected to generators, are shown. All the El Paso Company's plants develop the power they need, the facilities for this purpose totaling 28,110 kw of installed capacity.

**ROUGH COUNTRY**

It was tough going getting the line off the rim rock at the southern end of the Guadalupe Mountains in Texas. The 1200-foot drop on an average grade of 54 percent is the steepest on the southern branch of the system. A large double-drum hoist at the crest of the escarpment moved equipment up and down the incline. The pipe, in 60-foot sections, predoped and wrapped, was lowered into position by tractor-mounted hoists. To protect it from rough handling and the rocky ditch bottom it was wrapped in snow-drift fencing. The welders shown below are running five beads around the joint of two lengths of pipe.

Being an area of recent (geologically speaking) volcanic activity, much of the right-of-way was covered to a considerable depth with unconsolidated volcanic cinder and ash. The ditch-digging machines had easy going there, but behind them would be a trough only a few feet deep instead of the desired standard ditch. The loose material flowed back into the swath as soon as it was cut and necessitated shoring up the walls of the excavation with lumber—a painstaking procedure.

An unusual labor situation developed in preparing for the construction of a 218-mile stretch of main line and a compressor station that lie entirely within the Navajo Indian Reservation. In an agreement with the Navajo Tribal Council, it was stipulated that Navajos fill all the jobs for which they could qualify, and more than 250 were hired. Although most of them (about 80 percent) spoke no English and were unfamiliar with the work, the company was able through interpreters and with patience and capable instructors to train them rapidly and has recently classified them as a "smart, valuable, ambitious labor source." Many of the Navajos were promoted to skilled jobs as they qualified, and a number will be retained for permanent operating jobs.

Passed in 1908, the Federal "Law of Antiquities" stipulates that ruins and points of archaeological and historical interest on government land shall not be disturbed except by permission and under proper procedure in order to preserve them. Northwestern New Mexico and northeastern Arizona are rich in such treasures, known and potential, and a coöperative agreement had to be set up with officials of the National Park Service of the Department of the Interior so that the provisions of the law would be satisfied and pipe-line progress impeded as little as possible.

Jesse L. Nusbaum, senior archaeologist of the National Park Service, became consulting archaeologist to the El Paso Natural Gas Company, and five archaeologists were employed by the latter to work directly with the pipeline crews. Minor archaeological areas on the right-of-way were fully explored before construction was undertaken, but the line was rerouted around major sites such as large pueblo ruins that would have required weeks of excavation, mapping, etc. Some 300 sites of that character were found and were mainly of Pueblo Indian culture dating back to 700-1150 A.D. Museums were enriched with artifacts from the excavations, and a good deal of historical and archaeological data was accumulated.

Currently, the El Paso Natural Gas Company has 2800-3000 employees of whom about 1500 are on construction projects. The company not only builds practically all of its own pipe lines and structures but has an almost continual construction program underway. The incentive of new operating jobs thus created has enabled it to obtain and retain the best of experienced workers and has given rise to the boast that "our pipeliners may be the world's best—certainly none are better."

Maintenance is a major item in the operation of a pipe line, and this department calls for a large force of highly trained men. At the compression and treatment plants the work is much like that in well-nigh any industrial establishment, but the job of keeping a large cross-country line in top operating condition is, indeed, different. Emergency repairs may be difficult and often hazardous to make.

A pipe line has been described as a "twisting, writhing, temperamental, thin-skinned monster." It is affected by temperature changes, and because of the resultant expansion-contraction movements, engineering skill is required in laying the pipe and mechanical skill in constructing and maintaining it. Even slack loops and zigzag sections do not eliminate all dangerous stresses. This is

particularly true in hilly country where contraction when temperatures are low puts a terrific strain on pipe and joint at the crest of a hill. Where pipes are in contact with rough materials or objects, movement causes wear.

Stresses and abrasion are responsible for some of the dreaded leaks that must be quickly located and repaired, though floods have become the main cause of line breaks in recent years. Repairs must be made without interrupting service, and to weld a leak in a line carrying highly inflammable gas at 550-830 psi pressure is no chore for the inexperienced. Corrosion is another cause of leaks. All pipe laid is protected from corrosion, and considerable research has been carried out to determine the most suitable primers, wrappings and cathodic techniques for each of the soil conditions to which pipe lines are subjected.

The company attributes much of its operating flexibility, its ability to cope with emergencies and the initiative among its personnel to solve technical problems to its policy of building its own facilities. This reluctance to call in outside help, coupled with an urgent situation, was responsible for the development by members of its staff of the first economical method of treating large volumes of "sour" gas. According to available figures, it now processes more waste and acid gases than all the other organizations in the industry combined. Another "first" in "pipelining" is claimed by El Paso Natural: the initial 16-inch line from Jal to El Paso was the first natural-gas pipe line in the country of all-welded construction, and many improvements in technique made on that job contributed considerably to pipeline welding procedure generally.

Adhering rigidly to its "independence" policy, the company has provided a transportation system including just about every means of land conveyance and an adequate air arm. Elaborate telephone, radio, and telemetering facilities unite the entire network, and a 500-mile Philco microwave communications system now being installed on the Northern Line features the longest distance between stations yet attempted. The normal interval between relay stations is 20-40 miles, but several conveniently located mountain tops have made it possible to stretch the distance to approximately 50 miles in the case of this installation. The microwave equipment was developed in the Philco laboratories and can handle simultaneously 24 telephone conversations or several hundred teletype or telemeter channels.

The El Paso Natural Gas Company is looking sharply to the future. It estimates that its 1953 residue-gas deliveries will total 319 billion cubic feet, equaling in fuel value 53,170,000 barrels of oil and costing the company in payments to oil refineries some $19,150,000. If the applications for the $92,000,000 expansion program are granted by the Federal Power Commission, the company will be able to increase its daily deliveries from 1068 million to 1500 million cubic feet. The California distributors have indicated greater future demands upon the system: those tapping the Southern Line have expressed need for 150 million cubic feet a day to supplement their present contract for 405 million cubic feet, while the Pacific Gas & Electric Company on the Northern Line has asked that its present contract for 400 million cubic feet daily also be increased by 150 million cubic feet.

The value of the new pipe-line system to the economic welfare and growth of the vast area under consideration cannot be overestimated. It is a timely contribution made at no small cost in toil and capital and is proof not only of faith in the future development of our country but once again of the industrial resourcefulness of Americans. Compressed air has played a major role in all the construction work, and powerful compressors will keep the essential fuel moving to distant markets.

PHOTOS BY JOSEF MUENCH

**IN NAVAJO LAND**

The Navajos, most populous of the Indian tribes (62,000) live on the largest (16,000,000 acres) reservation in the country. They normally raise sheep, weave rugs, and make silver-and-turquoise jewelry, but many of the men have worked on pipe-line construction projects. The one pictured with his horses now is a guide, but had a taste of "pipelining" back in 1943 and liked it so well that he adopted the name of Pipeline. Because he was receiving some government checks he had to have a full name so he consulted his white friend Jimmy Brewer, at the Tuzigoot National Monument, who suggested "Bing" (after Bing Crosby) and "N" (no name) as a middle initial. This sounded good to the Navajo, and he is now Bing N. Pipeline. The woman pictured is wearing some of the tribe's handicraft. Her child is laced into a hand-made cradle board in which infants spend months of their early lives.

# Running Two to Eight Nuts at a Time

## Multiple-Tool Machines Serve Automotive Assembly Lines

**C. H. Vivian**

**RING-GEAR SUBASSEMBLY**

The operator has tightened five of the ten cap screws around the circle and has his thumb on the button that admits air to a centrally located cylinder. As shown, this actuates a piston that pushes downward and raises the machine so that it can be turned to engage the remaining five screws without the necessity of lifting it. The tools are the 380M type that was designed by Ingersoll-Rand Company especially to permit making a compact assembly. The side-to-center distance is only 1⅜ inches and the length 10⅜ inches. Each tool weighs less than 7 pounds but delivers 1.65 hp when supplied with air at 90 psi pressure.

MASS production has reached its present amazing stage of development in the United States because of our success in designing and applying machinery to further man's efforts. As machines do more, the rate of production increases, the chance of human error is reduced and the product tends to become more uniform. One of the marvels of modern industry is the automatic machine. It takes many forms, and performs widely varying operations in the making of myriads of different things. Back of our ingenuity is, of course, our high standard of living. It is almost an industrial maxim that, given an output sufficiently large, machines to aid manual work will be quickly forthcoming.

The automobile assembly line was the incubator of mass production and probably still is the best example we have of it. Automatic machines contribute importantly to numerous preliminary operations but can seldom be brought to bear on the final assembly line. In fact, much of the mechanization in evidence there consists in the use of relatively small hand-held tools because the nature of the work demands guidance by human hands and brains. Consequently, assembly lines still require the efforts of many people and very likely always will.

Early in the development of the assembly line it was apparent that there was room enough alongside for only a certain number of workers. With hand tools, then, the rate of movement and, hence, the volume of production depended upon the speed at which these people could carry out their allotted tasks. An increase in output could be gained only at the expense of human exertion. Fortunately, however, there were already in existence a few pneumatic tools that could be adapted to perform some of the operations involved, and other tools were soon devised to meet additional needs. This trend has continued and, through the years, the automotive industry has been the cradle of much pneumatic-tool development.

Not only have some tools been designed for specific purposes, but all the tools used in that industry have been improved and refined to increase their efficiency and ease of operation. In view of these facts, it would seem that little more could be done to better the services rendered by them; but, actually, a recent advance has made it possible to reap some of the advantages inherent in the automatic mechanisms used in the production of parts.

The fruit of this new display of ingenuity is the multiple nut runner developed by Ingersoll-Rand Company. It came into being because it was noticed that, at a considerable number of places on automotive assembly lines, the same work was being carried out from two to five and more times, using one or more tools. It was realized that it would be of advantage if equipment could be provided that would perform these duplicate operations all at once.

From this observation and subsequent studies evolved the idea of combining in a cluster from two to eight tools, positioned and spaced to fit the requirements of the job in hand and capable of being run as one tool. Actually this had been done previously in at least one instance, but not in the automotive field. During World War II, an aircraft-engine manufacturer joined three Ingersoll-Rand Size 00 pneumatic drills to run down quarter-inch cap screws that held the cover on the rocker arm of its airplane engine. This unit was used with good results, but no further effort was then made to exploit it.

The first talks about applying the idea to the motor industry took place in Detroit two years ago. An Ingersoll-Rand representative at once made up some sketches for the first of the multiple-action tools. In due time the ma-

chine called for emerged from the shop and was put to work. It scored an immediate success, and this led to the development of others. Many of them are now used by automobile manufacturers and are performing a variety of tasks virtually all of which, however, involve the running of either nuts or cap screws.

The principal benefits realized by these multiple-spindle tools are what the trade calls "quality control" and a saving in time. Quality control in this case means that all the nuts, for instance, in a given operation can be tightened to the precise degree that will give best results. This uniformity is naturally highly desirable, and when there is surety that it can be achieved it is frequently possible to eliminate subsequent checking operations.

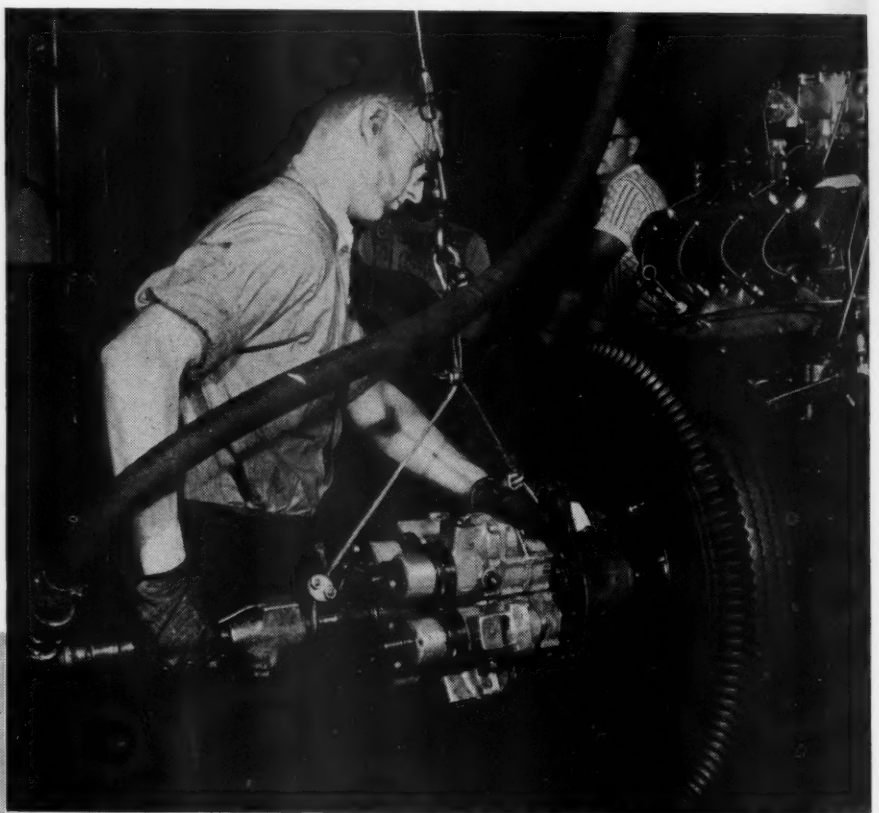
The reason uniform torque can be obtained at all the spindles is simple. It is common practice in work of this sort to run air tools until resistance stalls them. Since all the tools in a unitized machine are identical, and the air is fed to them through a common backhead, it is obvious that they will all stall at the same point of resistance and will, of course, do the same amount of tightening. This stalling, incidentally, does not hurt the tools.

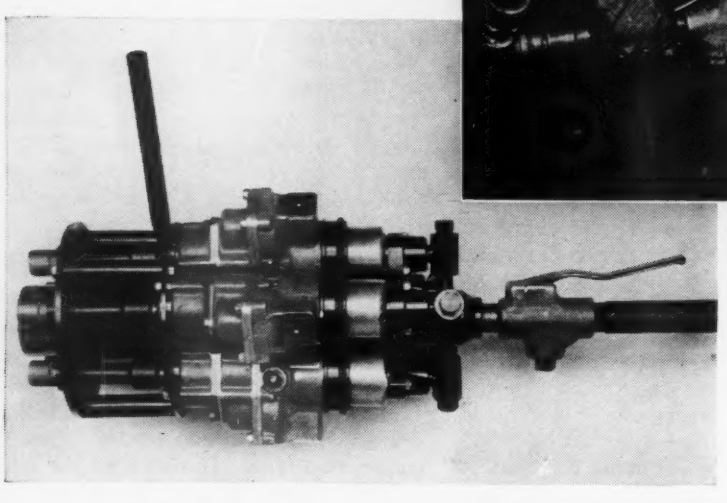
The desired torque can be obtained merely by controlling the pressure of the air. It is generally an easy matter to determine the optimum torque by experimenting with a single tool and varying the air pressure until the correct one is found. In making up a multiple-unit machine, a tool is selected that will develop the wanted torque at a pressure from 15 to 20 psi less than the available line pressure. This allows ample leeway for any subsequent increase in torque requirement or tool wear. A regulator is then interposed in the machine's air line to reduce the pressure, as needed. The pressures actually used range from 50 to 90 psi. As starting the several tools in unison imposes a sudden, heavy drain on the air supply, hose and fittings must be of ample size. In some cases it is also desirable to place an auxiliary receiver near locations where the machines are in operation.

Multiple-tool machines will often show tremendous savings in time. Sometimes this is important, sometimes not. For instance, under the procedure formerly followed, a worker may have been hard put to perform his assigned job fast enough to keep up with the movement of the assembly line. In that case a reduction in time is a distinct boon that makes for better labor relations. But if he had plenty of time his lot would not be eased appreciably. Moreover, a saving in time may mean nothing while a line is moving at its present pace, but it can possibly help to increase production later on if a change in line schedule is made. In other words, time saving is not now a factor, but it may be later on.

The initial machine was designed to simultaneously run five hexagonal nuts on lugs that hold an automobile wheel in place. This had previously been done by one man using an air-operated impact wrench on each of the nuts in turn. The new unit consists of five Ingersoll-Rand No. 2 Multi-Vane drills mounted radially in a holder and fitted with a common backhead and a single throttle. In this instance the nuts are given one turn by hand. The machine is then started and the sockets slid into place over the nuts. This requires little exertion by the operator, because the machine is suspended from a spring balancer. To facilitate making contact with the five nuts at one time, the sockets are spring-loaded to provide about 3/16-inch end play.

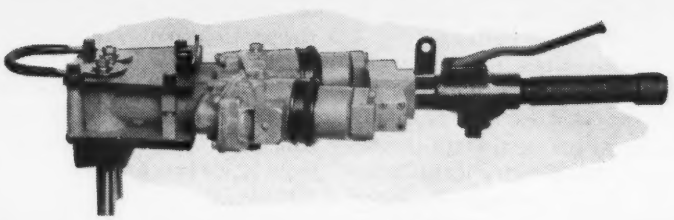
The next machine developed was for simultaneously tightening five cap screws on the differential ring-gear assembly of one of the popular makes of small cars. There are ten retaining cap screws in a circle, and they are tightened in two operations, alternate members being engaged each time. Because the circle of screws is too small to permit combining five standard tools within the available space, a special tool was designed with a smaller side-to-center distance. It is known as the 380M motor and has since been incorporated in other machines where extreme compactness is necessary. The slenderized effect was achieved by using planetary reduction gears.





**RUNNING NUTS ON WHEEL LUGS**

With this 5-tool machine, which is used by several leading car manufacturers, a wheel can be secured in approximately seven seconds. Using air at a pressure of 75 psi, a torque of 100-110 foot-pounds is obtained. The tools are Ingersoll-Rand No. 2 drills. The assembly weighs 98 pounds and is the heaviest of the multiple-spindle units built thus far.



**SPRING AND AXLE ASSEMBLY**

Aside from the time saved in running four nuts on two U-bolts simultaneously (top picture), the multiple-tool machine does the job better because when each of the two opposing nuts is run down separately there is a tendency for one to loosen when the other is tightened. This picture illustrates clearly how these unitized pneumatic machines are suspended from overhead spring balancers that eliminate practically all human lifting. Below is a 2-tool combination that is used in one plant for U-bolt nut running. It consists of 28M angle wrenches. The average time required to tighten four nuts with it is 13-14 seconds.

To facilitate indexing or turning the machine after it has run down half the screws—to put it in position to engage the remaining five—a centrally located air cylinder was built into it. When the operator presses a conveniently located button, air is by-passed into the cylinder and a piston emerges from its lower end for about 1½ inches. This lifts the tool assembly, which is then balanced on this central point while it is rotated so as to spot the tool sockets over the five screws still to be tightened. Releasing the air pressure in the cylinder lowers the machine.

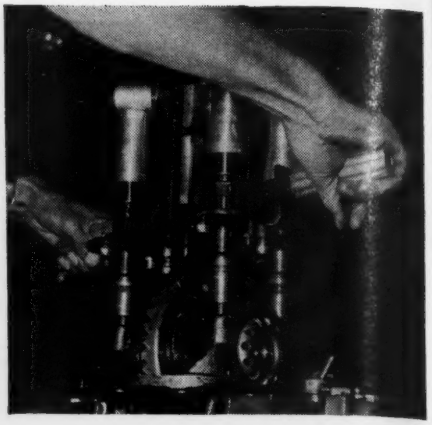
Before this multiple-action machine was introduced, three men performed the operation with individual nut runners. As the units passed by on the assembly line, the first man would tighten three screws, the next one three, and the last one four. From time to time this order would be changed so that the work came out about even. The line moves at a rate of 275 units an hour (more than 4½ per minute) and the operators were hard pressed to maintain the pace. In fact, a relief man came on for a time every hour to rest each regular worker in turn. Now two operators, each with one of the 5-spindle machines, handle the job with ease. Moreover, the cap screws are run down with such uniform tightness that it has been possible to eliminate checking with a torque wrench.

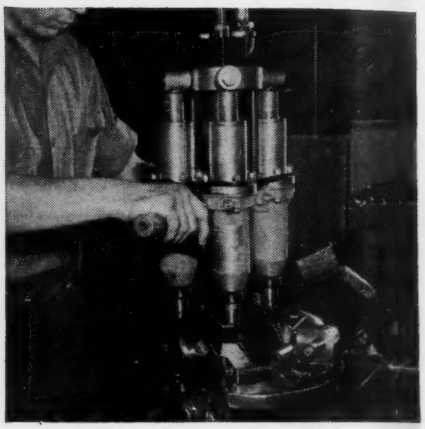
A machine that does the same job on another make of automobile incorporates eight tools—the greatest number so far combined. In this instance eight instead of ten cap screws are used and are arranged in a circle large enough to permit grouping eight tools in a ring to match the spacing of the screws.

Machines for running nuts on U-bolts that hold the rear spring and axle assembly together have been furnished several car manufacturers. In the typical case there are two bolts each with two nuts to be affixed, thus requiring a 4-tool unit. Size 2P motors have been utilized for the most part, and the advantages gained include both time saving and better quality control. The nuts are ordinarily applied while the threaded ends of the bolts extend upward. However, when installed on a car, the assembly is turned over. Consequently, if it is necessary later to adjust the torque of the nuts, this must be done in a pit by a man working overhead. Obviously, it is a

**SHACKLE-BOLT NUT**

This combination of two 2EL wrenches saves a leading motor-car maker 20 percent in time and improves the quality of the work an estimated 80 percent, as compared with the former procedure of tightening each bolt.





**DIFFERENTIAL BEARING-CAP ASSEMBLY**

In this operation, bearing-cap retaining nuts are run to the desired tightness, the assembly is machined, then torn down, bearings are inserted and final assembly is made. In the foreground of the left-hand view, nuts are being run on with a machine made up of four 0NB drills. In the background, nuts are being run off with a unit consisting of four Size 508 impact wrenches. Close-ups of these respective operations are shown at the right.

slow, undesirable, and costly operation, but it has been fairly common in the past because it is a difficult matter when coping with one nut at a time to tighten the two nuts on a single U-bolt uniformly. Since the multiple-spindle machine runs down the nuts on opposing sides of the bolt at the same rate of speed, it naturally does the job better and eliminates the need of making subsequent adjustments in the pit. While most automobile concerns that have adopted the new technique use a 4-tool machine, one leading company has a 2-tool unit. It is made up of two 28M angle wrenches.

In another application two machines facilitate the placing of bearing caps on a car differential. The cap is first assembled with the desired degree of tightness, then machined, dismantled, the bearings are added, and finally it is reassembled. There are four retaining nuts, and they are run on with four 0NB drills, which do the job in approximately half the time previously required. In the dismantling process, the nuts are removed with four No. 508 impact wrenches acting in unison. The time it takes to do this is roughly one-fourth of the former period.

Still another machine consists of two 28L wrenches mounted together to fit the rear shackle bolts on a popular car. As compared with the previous one-at-a-time performance, there is a time saving of 20 percent and an increase in quality estimated at 80 percent.

Not all the machines built so far are serving the auto industry. One, for example, is being used by a large manufacturer of electrical equipment to run down two nuts that secure a transformer cover. Two of the specially developed slender 380M motors are employed for this purpose.

Actually, these multiple nut-running machines can be utilized to advantage in assembling machinery of almost any kind. In general, they will justify their cost wherever from two to five or more nuts or cap screws have to be run and where the spacing between them is uniform. Potentially favorable fields include factories that produce tractors and all types of farm machinery. In the current defense-mobilization movement they can doubtless be profitably applied to the building of tanks. They promise to be especially helpful in the coming days when labor is probably going to be scarcer because workers can do a satisfactory job with them without previous training. This also goes for women, who may soon again make up a substantial proportion of our industrial army.

Even though several tools are running at one time there is no torque reaction on the operator. Apparently each tool absorbs the reaction of the others, and the entire group is as easy to hold as a single impact wrench. The heaviest machine thus far assembled weighs 98 pounds, but the weight imposes no problem when the set of tools is suspended from a spring balancer that does the lifting.

Experience to date has shown that maintenance of the multiple-tool machines is probably less than where individual tools are in operation, probably because they get better treatment. It is not unusual for a machine to be in service eight months without requiring attention. All the tools are of the vane type, and in time vanes wear so that they have to be replaced. The tools are assembled into a unit in such a manner that it is easy to remove one or more of them if occasion demands. In the event one tool has to be replaced for some reason and a new one is then running with several older ones that have been subjected to wear, it is still possible to make sure that all will continue to exert the same torque. This is effected by varying the speed of the several tools by means of individual regulators built into the common backhead.

# Twenty Miles of Air Lines

## Air Power Is Indispensable Aid in North American Aviation Company Plants

Data and pictures from Compressed Air and Gas Institute

**TOOL APPLICATIONS**

Although conventional riveting hammers are used to form most metallic connections, squeeze riveters such as the one at work above can be employed in some favorable locations. Using air at 90 psi it will exert a force of 5200 pounds. The other picture shows a pneumatic saw cutting a piece of aluminum.

THAT compressed air is essential to the building of a 70-group Air Force becomes apparent when one inspects the facilities of North American Aviation, Inc., which began the year with a backlog of orders for more than 1000 military airplanes that exceeded $400,000,000 in cost. The principal types in production are the B-45 four-jet bomber, which has a wing span of 89½ feet, a length of 74 feet, and can carry more than 10 tons of bombs, and the F-86 fighter with the sweptback wings that is capable of flying more than 650 miles an hour.

The uses of air in the company's plants range from the operation of thousands of pneumatic tools to the supersonic testing of airplane models. Especially noteworthy is the ease with which this adaptable power medium has been put to work on new orders because of the adoption of a standard pattern for the supply system. This applies to both the main factory at the Los Angeles municipal airport and the subsidiaries.

Distribution of compressed air is considered as important as distribution of electricity. The lines of both of these utilities are generally spaced 12 feet apart, with outlets every 8 feet. This arrangement may be changed slightly according to variations in the spacing of building columns. Though the initial cost of following such a standard pattern is greater, it increases operating flexibility, especially in the case of assembly work. J. P. McNamara, North American plant engineer, credits it with appreciable long-range savings. Working areas can be adapted quickly to the needs of small orders or to changes on models in large-scale production.

There are more than 20 miles of air lines, including 2 miles of primary distribution piping, in the main plant. Pressure drop is held to a minimum by the use of correctly sized pipe and a loop system that gives 2-way delivery to points where the demand for air is greatest.

Pneumatic tools are favored because of their light weight in relation to their power output and their durability. These important factors tend to increase production and to reduce maintenance costs. The tools not only differ in type but there are numerous sizes and varities of each type. Air-operated saws cut aluminum quickly and accurately, and midget air drills have many applications. Riveting hammers are, of course, used extensively, as are yoke and compression riveters. Other pneumatic portable tools include grinders, buffers, nut runners, screw drivers, chipping hammers, and wrenches.

Among the uses of air power for purposes other than driving tools, one of the most interesting is that of simulating conditions of supersonic flight. Miniature planes no larger than a child's toy are placed in a small tunnel. Air at a pressure of from 115 to 150 psi is first dried, and then its velocity is increased to supersonic range by passing it through a venturi throat leading into the tunnel. Even though this is continued for only a very short time, the volume of air required is so large that the tests are usually made at noon or some time when the other demands for compressed air are not at their peak. This is but one of several tests conducted by means of compressed air.

The machines employed for stretching sheet aluminum have pneumatic jaws. Air hoists are located in places such as paint-spray rooms where spark-free operation is necessary for safety. A quick-quench furnace uses air power to open its door and then to drop a ram that immerses heated metals in water. Air valves control the air conditioning system in the department where the expensive miniature test airplanes are made of wood, and air pressurizes the water for the spray quench in the heat-treating section. In the case of the latter, centrifugal pumps served at first, but the costlier application of compressed air was considered more eco-

**PNEUMATIC TUG OF WAR**

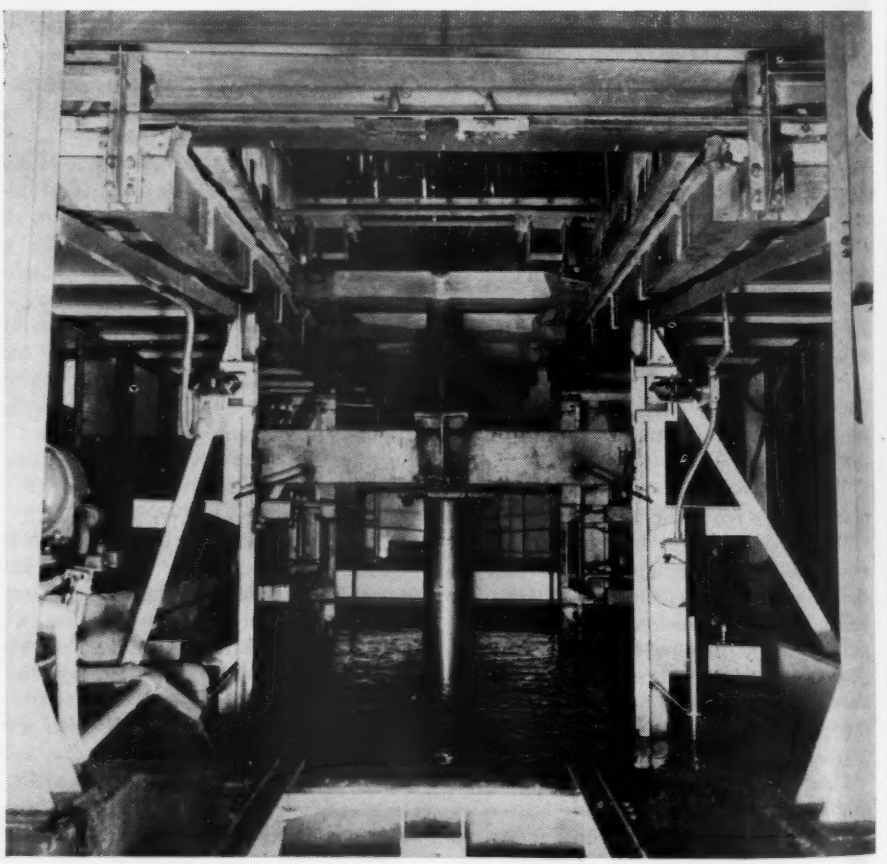
These air-powered jaws take tighter than a bulldog grip on the ends of the aluminum sheet, holding it while the camel-back under it is raised to stretch it, as desired.

nomical in the long run because it eliminated the dirt that was pumped in with the water by the former method.

The central air compressing plant consists of two 2-stage compressors each of 1500-cfm and of two units of 650-cfm each. Another machine of 1600-cfm capacity that was added later is located separately. It is used primarily for the supersonic testing tunnel.

Because compressed air is one of the main sources of plant power, the engineers are continually on the alert to maintain the system at peak efficiency. Most of the pneumatic tools, for example, deliver full output when operated with air at 90-psi pressure. Pressure drop at the tool means less work done, which explains why the company insists on a well-engineered air-supply system. Also, selection of the right tool for a given job improves production. Since manufacturers provide a wide variety of tools to meet all working conditions, the company takes pains to choose those that best answer the different needs.

These routine plant procedures help put in the sky more and better fighter planes that are breaking speed records and adding to our military might.



**QUICK-QUENCH FURNACE**

The doors on this electrically heated furnace are air operated, as is the vertical plunger in the center. By means of the latter, heated parts may be quickly lowered into the water bath.

# Leadville Drainage Tunnel

## Bore on Which Work Was Resumed in 1950 Will Unwater Millions of Tons of Vital Ores

MILLIONS of tons of lead, zinc and manganese ores are being liberated from a watery grave high in the Colorado Rockies. Flooded mines with blocked-out ore reserves are being drained by a 10,100-foot tunnel fast nearing completion. The Leadville Drainage Tunnel, near historic Leadville, has tapped some of the main watercourses in the district's principal mining section. The water level in the area affected is receding, and volumes up to 3765 gpm have been measured at the tunnel portal.

Water plagues mine operators the world over. There is usually too little or too much. In either case, it can be the factor that "kills the mine." The "too-much" water in the Leadville workings is attributed to melting snows from higher altitudes. Engineers of the U.S. Bureau of Mines have estimated that the total amount of water from that source finding its way into the Leadville mines through faults, fissures and other subsurface means averages 6000 gpm.

The battle against water in the Leadville District is as old as the flooded mines themselves. When underground operations started in 1874 with the discovery of silver-lead ores, water was the miners' worst enemy. In 1878 Leadville was referred to as "the greatest silver camp in the world." The Denver & Rio Grande Railroad reached the town in that year. Some 35,000 people in the district were living high on the basis of $15,000,000 in gold, silver and lead produced from about 30 mines and treated by ten smelters. It was a boom year for the community, but even then water was a threat against the continued prosperity of the camp.

Pumps were installed in individual mines that could afford them. Deeper workings were draining the more shallow

**MEASURING FLOW**

M. F. Buckbee of the U. S. Bureau of Mines is shown recording the flow of water through a weir a short distance from the tunnel portal.

**PORTAL OF TUNNEL**

When this picture was taken, the ditch was carrying about 3600 gpm of water, enough to supply the normal requirements of a city with a population of 25,000.

neighbors, and disputes arose. Then, as the mines extended laterally and in depth and water increased in volume, common interest and necessity brought about joint pumping enterprises. Cooperative attack kept the water out, but it didn't keep the price of metals high and the employee-employer relations harmonious. Slumps in the price of metals and labor disputes caused the closure and the consequent flooding of the mines. Prior to 1933 those properties now being reclaimed by the Leadville Drainage Tunnel were pumped out seven times.

A goal set in 1932 is being partially attained with the completion of the tunnel. The Public Works Administration failed to approve the proposal in 1933, 1935 and again in 1938. Early in World War II the War Production Board had the Bureau of Mines review the case and investigate it thoroughly. Bureau engineers verified the feasibility of the tunnel and pronounced it an economical means of unwatering the mines so that the existing ore could be extracted. Their estimates of the values recoverable from the drained mines are as follows: two million tons of sulphide ores averaging 15 percent zinc, 3 percent lead, 3 ounces silver, and 0.02 ounce gold; one million tons of oxidized ores averaging 14 percent zinc; and perhaps an additional million tons of ore carrying 16 percent of manganese. Probable extensions of these ore bodies and new ore horizons are not taken into account in these figures.

Funds were appropriated by Congress,

**TREACHEROUS GROUND**

Fighting their way foot by foot through badly fractured quartzite, left, the miners are shown placing special timbering to support the enormous overhead weight and curb the flow of fine material into the heading. The other picture shows the steel sets and timber lagging necessary to hold out loose rock.

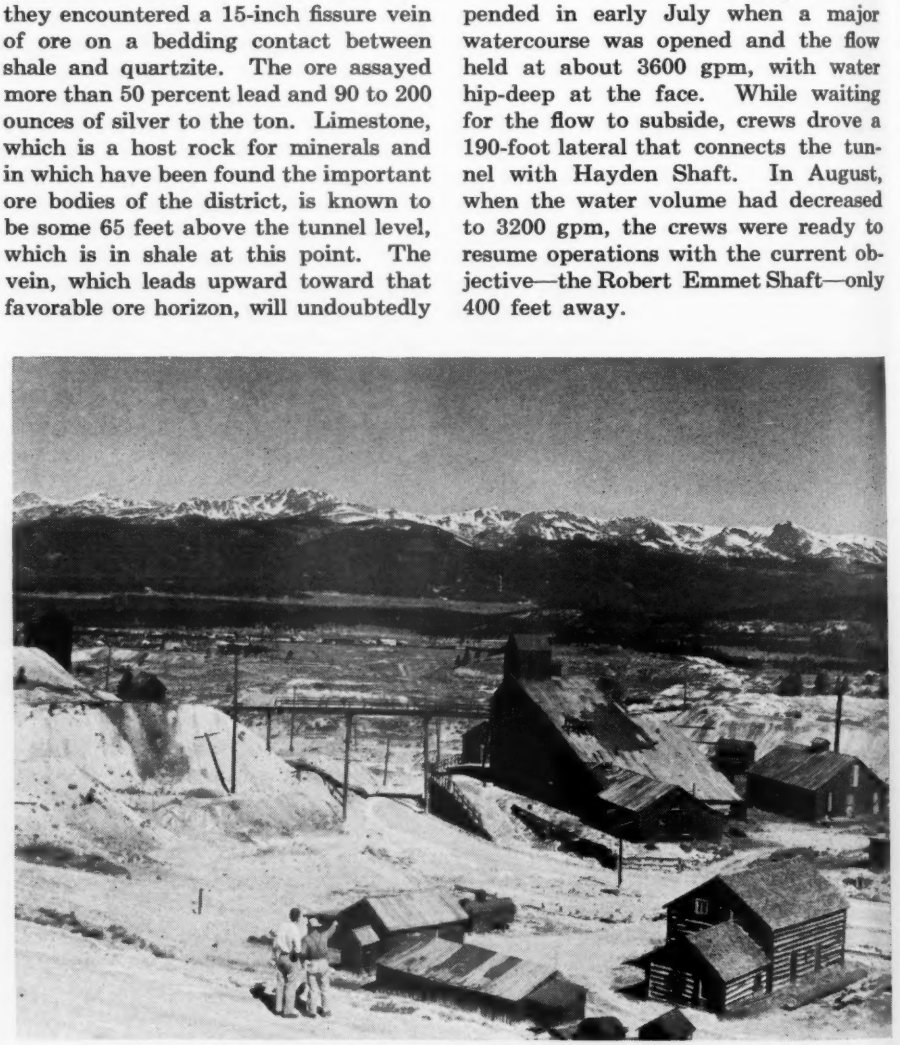
and the tunnel was started in December, 1943. The portal was cut near the banks of the East Fork of the Arkansas River at Elevation 9957 (a slightly revised location) and below most of the extensive workings of the old mines of the four principal ore-bearing subdivisions of the large Leadville District. Mines of the Fryer Hill, Carbonate Hill, Iron Hill and Downtown Section produced most of the $486,000,000 and more in metals credited to the camp since the discovery of gold in nearby California Gulch in 1860, and they embrace the recoverable ore reserves tabulated in the preceding paragraph.

Underground conditions proved a great deal worse than had been expected, and by August, 1945, funds were exhausted and work was suspended, with the tunnel face in only 6600 feet—far short of the 17,300-foot goal that included a 3500-foot lateral to drain the Downtown Section basin and another 2400-foot arm to unwater the Iron Hill basin. The project once again had to be shelved and wait for Congress to appropriate the money necessary for its completion.

Additional capital was made available in mid-1950, although only enough to carry the tunnel to the Robert Emmet Shaft at the 10,100-foot mark. The Utah Construction Company of Salt Lake City was awarded the contract to continue operations under the direction of J. H. East, Jr., Region IV Director of the Bureau of Mines. Work was begun in September, 1950, with some 55 men employed. The cross section of the bore was reduced from 9x10½ feet to 7x9 feet to conserve funds and to speed advance.

As the heading approached the mine areas, mineralization became evident and the possibility of developing "new" ore instilled enthusiasm in the tunnel-driving crews. They did have that satisfaction when, at the 8573-foot mark, they encountered a 15-inch fissure vein of ore on a bedding contact between shale and quartzite. The ore assayed more than 50 percent lead and 90 to 200 ounces of silver to the ton. Limestone, which is a host rock for minerals and in which have been found the important ore bodies of the district, is known to be some 65 feet above the tunnel level, which is in shale at this point. The vein, which leads upward toward that favorable ore horizon, will undoubtedly be exploited in the very near future.

Work in the tunnel heading was suspended in early July when a major watercourse was opened and the flow held at about 3600 gpm, with water hip-deep at the face. While waiting for the flow to subside, crews drove a 190-foot lateral that connects the tunnel with Hayden Shaft. In August, when the water volume had decreased to 3200 gpm, the crews were ready to resume operations with the current objective—the Robert Emmet Shaft—only 400 feet away.



**LEADVILLE SKYLINE**

The snow-clad Sawatch Range, dominated by sprawling Mount Massive (Elevation 14,418) which is Colorado's second highest peak, forms an impressive backdrop for dumps and buildings of mines that have yielded minerals valued at $486,000,000. The Robert Emmet Shaft in the right foreground is the objective of the drainage tunnel.

# More Power at Niagara

ANOTHER huge hydroelectric plant is in the making at Niagara Falls. Situated on the Canadian side of the stream, it will produce 600,000 hp and will be laid out to permit doubling its capacity. The project is being carried out by The Hydro-Electric Power Commission of Ontario and represents the largest single undertaking ever handled by that organization. The total cost will exceed $157,000,000, and the initial generation of power is set for 1954.

Construction was made possible last year by the signing of a 50-year treaty between Canada and the United States providing for the diversion of additional water from the Niagara for power production. Due allowance for the preservation of the scenic beauty of the falls was made by leaving enough water in the stream for that purpose.

Water will be taken from the river at a point 3 miles above the cataract and directed for 8 miles to the powerhouse located 5 miles downstream from the falls and adjacent to the existing 525,000-hp Queenston Station. For the first 3500 feet it will be carried in a cut-and-cover concrete structure, whence it will enter a 5-mile pressure tunnel from 200 to 300 feet below the surface and passing under the city of Niagara Falls, Canada. Emerging from the tunnel, it will flow in an open canal for 2½ miles to the forebay of the generating station.

Construction involves the removal of some thirteen million cubic yards of earth and rock, of which two million will come from the tunnel which will be excavated to a diameter of 51 feet, or only 5 feet less than the record-size diversion tunnels driven at Hoover Dam on the Colorado River in 1931. It will be lined with concrete to a finished diameter of 45 feet. At the building site it will be necessary to cut down a 300-foot cliff to provide room for the power plant at the base and for the penstocks that will lead down to it. This will entail the movement of around five million cubic yards of material.

Preliminary to construction, 42,000 feet of diamond drilling was done to test the underground formations, which consist of beds of dolomite, limestone, shale and sandstone. Included were 60 holes totaling 12,000 feet along the tunnel line to determine the most favorable rock for the bore. It was decided to drive it at the junction of the Grimsby sandstone and the overlying Irondequoit limestone, both of which seem to possess sufficient stability to stand without support. The strata dip or slope at the rate of about 28 feet to the mile in the direction of the tunnel line, and the latter will follow that grade.

To facilitate operations, four shafts will be sunk at approximately equidistant points and headings will be opened in both directions from each, making eight points of attack in all. Contracts have been awarded to Rayner-Atlas Ltd. and to Perini, Pitts & Associates, each of which will sink two shafts and drive one-half of the tunnel section. Two of the shafts will be 32 feet in diameter and the other two 30 feet. The deepest will bottom at 330 feet and the shallowest at 210 feet.

The shafts will be located 125 feet to one side of the tunnel line, to which crosscuts will be driven. The purpose of the offset is to allow the same shafts to be used later in case it is decided to excavate a second tunnel. With that in mind, they will be lined and kept in good order. Meanwhile, the crosscuts will be sealed with concrete plugs. The large size of the shafts will permit lowering heavy and bulky tunneling equipment through them.

Details of the tunnel-driving method have not been worked out, but it is expected that a drill carriage mounting approximately 30 drifters at four working levels will be used at each heading. It has been calculated that about 240 feet of drill hole will be required for each foot of advance. Full-size power shovels will load blasted material into either diesel trucks or electric cars. Ventilation may pose a problem, because test borings indicate that there is some natural gas in the ground. To tap it off, one of the contractors is considering drilling a 12-inch hole every 400 feet.

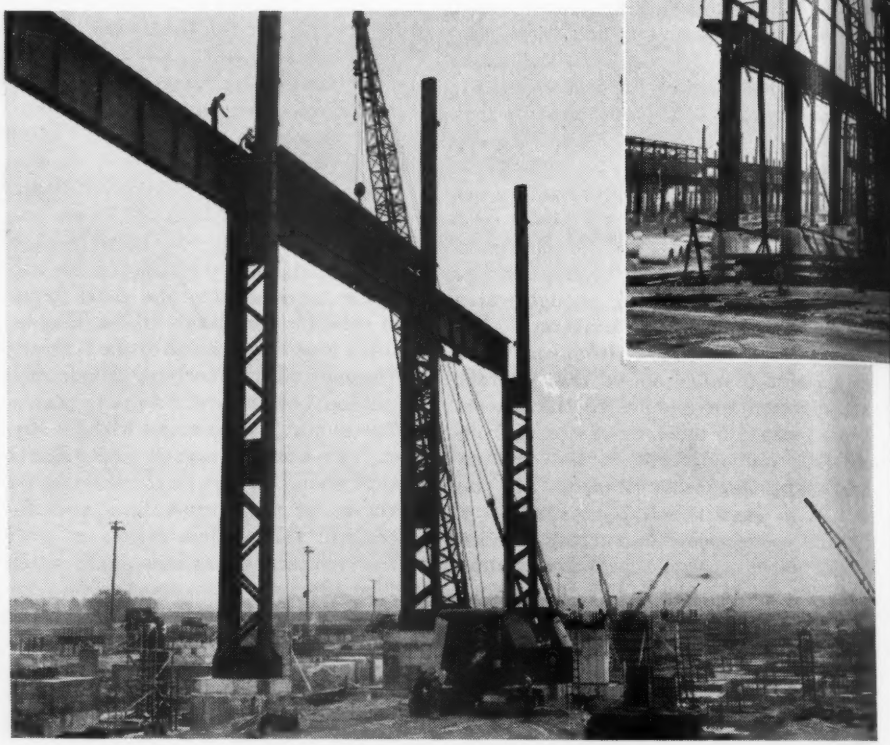
The intake, open canal, forebay, and powerhouse will be built by the Hydro Commission's own forces. The canal will be 200 feet wide and approximately 60 feet deep and have a carrying capacity of 40,000 second-feet, or double the quantity of water needed for the present development, thus providing a reserve for possible expansion. From the top of the cliff, six penstocks, each 19 feet in diameter, will carry the water to six 100,000-hp turbogenerators in the power plant, which will be called Sir Adam Beck-Niagara Generating Station No. 2.

Work on the various phases of the project is underway and more that 2000 men were employed during the summer. This force will be gradually increased until a peak of around 5000 is reached in the fall.

**POWERHOUSE SITE**

The Queenston plant and, left of it, the site of the new 600,000-hp station showing excavation in progress on the 300-foot cliff. Approximately five million cubic yards of earth and rock will be removed from this area.

# Fairless Steel Works Rises



THE accompanying pictures, taken on August 2, show four months' progress in the erection of the United States Steel Company's $400,000,000 Fairless Works near Morrisville, Pa. Early last March the 3800-acre site in a bend of the Delaware River had only been partially cleared of farm homes and buildings and surrounded with 15 miles of wire mesh fence. A single railroad spur had been run in, no excavating had been done, and no building materials were on the ground. A few days later, however, the whole place was swarming with contractors' crews, dirt was flying, equipment was arriving by train and truck, and activity extended pretty much around the clock. As matters stand now, a batch annealing plant will go into service this fall for treating material shipped from Pittsburgh, other finishing departments will be ready for operation a little later, and the basic steelmaking sections of the huge mill will begin functioning in the early part of 1952, as scheduled.

When the plant was first visualized, the company's construction bureau consisted of a chief engineer, an assistant, and a few draftsmen. As planning progressed, it grew to include six officials, 65 engineers, 100 draftsmen and 35 clerks. These and several outside engineering firms tackled the big job of building the mill on paper. All told, 80,000 drawings were made, and the preliminary engineering efforts added up to around 9½ million man-hours, equivalent to the labors of one man for 4000 years. During construction, supervising engineering will come to an additional 2,000,000 man-hours or more.

When the outbreak of fighting in Korea speeded up the construction schedule, things really began to hum. To obtain a topographical survey of the almost level tract as quickly as possible, aerial methods were adopted and, after checking, the result became the basis on which the quantity of fill required for building areas was calculated. Another preliminary step was the making of 200 borings to test the suitability of the subsurface for foundations. The explorations revealed a layer of sand and gravel, ranging from 10 to 20 feet in thickness, underneath a 5 to 10-foot mantle of topsoil and loam. Farther down are other strata of sand, gravel and clay, and at a depth of 75 to 150 feet is mica schist. The foundations of most of the buildings and structures will be carried down to the uppermost sand horizon, although in the case of some of the heavier ones piling will be driven.

**OPEN-HEARTH AREA**

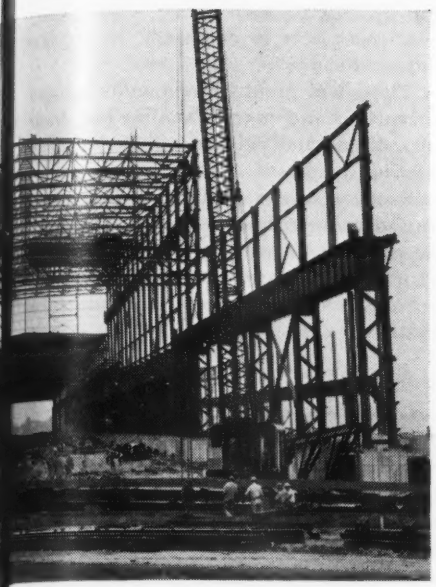
An American Bridge Company crane lifts into place the first steel members for the open-hearth building, other piers for which are seen in the background. The completed structure will house nine furnaces, each of 250 tons capacity.

When work began, the surface of the site was from 5 to 16 feet above sea level. As the plans call for the establishment of building grades at 20 to 25 feet and roads and yards at 20 feet, the filling in involved necessitates the handling of 7,000,000 cubic yards of earth. Included in this total is the excavation of a slip deep enough to permit docking ships that will bring in raw materials and take away finished products. By June 20 approximately 2,000,000 cubic yards had been moved, and the appearance of the tract had been so transformed that a former resident was 500 yards off in his guess as to where his house had stood.

Despite the widespread changes wrought, the builders have not wantonly destroyed anything in this history-rich section. With the help of archaeologists from the Pennsylvania Historical Society, the bodies in two old cemeteries were reinterred in new burial plots where the graves will receive perpetual care. Materials from several of the old structures on the site were carefully preserved and donated for use in the additional restoration of Mount Vernon, the Virginia home of George Washington. Some dwellings were moved intact to other locations, and some were dismantled and reconstructed elsewhere.

A few figures will give an idea of the size of the plant when it has been completed: There will be 175 acres under roof and 70 miles of railroad tracks within the grounds. For foundations and other structures, 500,000 cubic yards of concrete will be poured, enough to construct a highway 20 feet wide, 8 inches thick and 200 miles long. This concrete is now being placed at a rate of around 2000 cubic yards daily. In general, the mill buildings will consist of structural-steel skeletons and corrugated steel siding. They will be windowless, necessitating artificial lighting, and will be ventilated by means of openings at ground level and in the roofs.

Each of the two blast furnaces will be 105 feet high and have a 28-foot-diameter hearth. Foundations for it and associate structures will require 53,000 cubic yards of concrete, while its super-

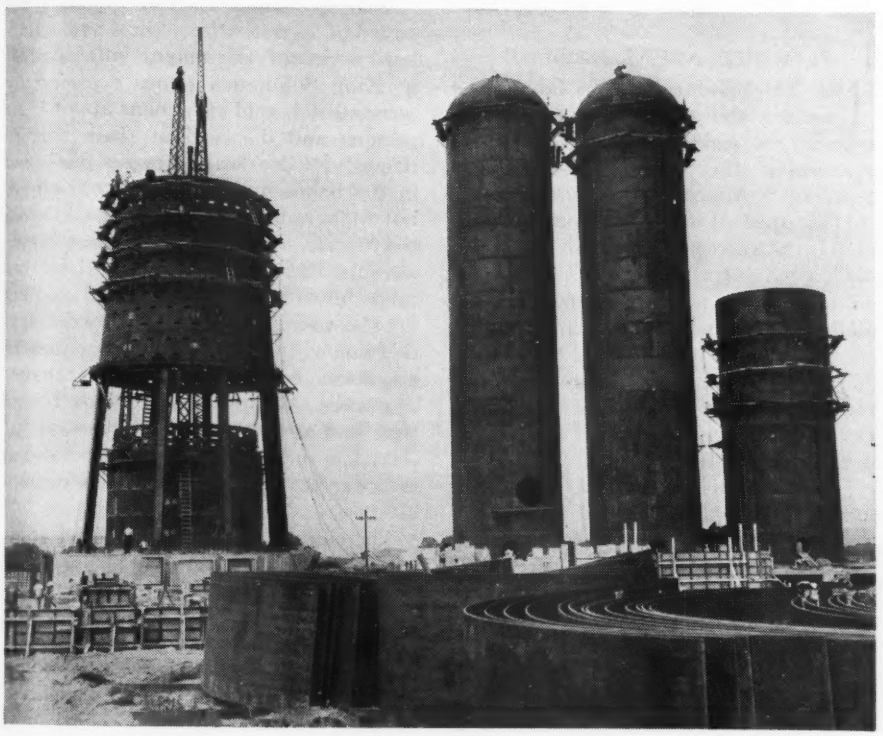


**CONTINUOUS ANNEALING BUILDING**

As the picture shows, this structure is well along. It is scheduled to go into service in October and will, for the time being, treat material shipped from other U. S. Steel plants in the Pittsburgh area.

cent of our steel is produced today, was developed around 100 years ago largely through research carried on at the Trenton Iron Company, formerly located less than 6 miles from the Fairless Works.

Supplementing these basic facilities will be a primary mill for rolling steel ingots into slabs and blooms, a continuous-type 80-inch hot-strip mill, a full complement of sheet and tinplate finishing facilities including cold reduction mills, and billet, bar and skelp mills to furnish material for the pipe-making



**NO. 1 BLAST FURNACE**

One of the two blast furnaces that are being provided and the three stoves that will heat the blast of combustion air to be delivered by a turboblower. Each furnace will be 105 feet high when completed.

structure will call for 4000 tons of steel and 3,000,000 refractory bricks for lining. There iron ore, limestone and coke will be brought together with air to produce the basic pig iron for the diversified steel products the plant will turn out. Each furnace will be tapped five times a day and yield around 300 tons of iron each time.

The pig iron will be converted to steel in nine open-hearth furnaces, each of which will require 2,000,000 bricks, enough to build 125 six-room houses. Some of these bricks will cost as much as $2 apiece. It is significant that the open-hearth process, by which 90 per-

plant that will be operated by the National Tube Company, another U. S. Steel Corporation unit. Combined, they will turn out 1,800,000 ingot tons of steel annually and process it into numerous useful products.

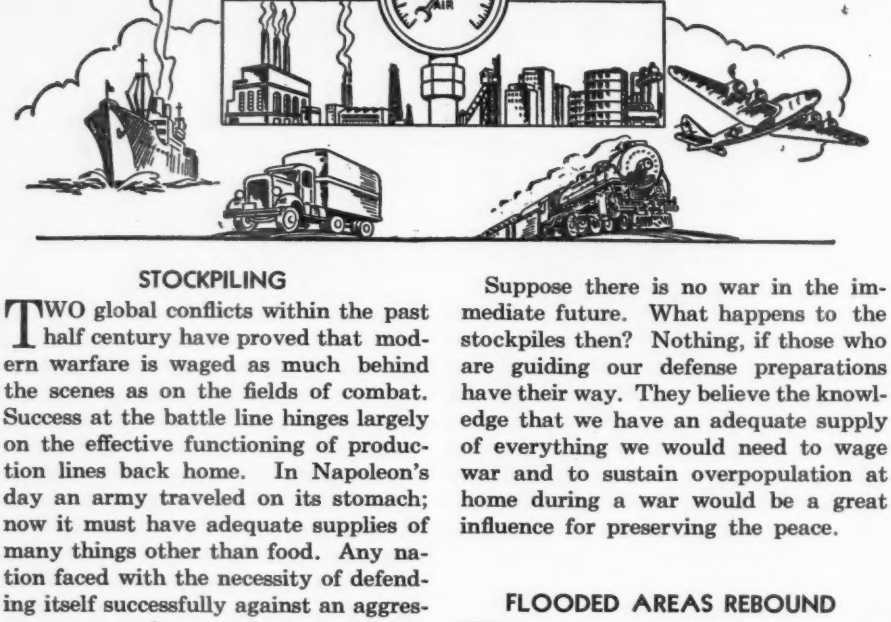
In general, it takes 3 tons of raw materials to make a ton of steel, not to mention the huge volumes of air fed to the blast furnaces. A year's supply for the Fairless Works would fill a train of hopper cars 1250 miles long. For the time being, the iron ore, coal and limestone that make up the bulk of the constituents will arrive by railroad. Later on the ore, at least, will be delivered by boat, and equipment is being provided to unload it at a rate of 1500 tons an hour and then convey it by belt either to the blast furnaces or to storage areas.

At full capacity, the plant will use enough electricity to supply the normal needs of a city of 450,000 persons. The main motors of the hot-strip mill alone will exceed the 34,000 shaft horsepower that drives the liner *America*, the nation's largest commercial vessel. Some of this power will be generated and the remainder purchased. The 9,000,000,000 cubic feet of natural gas the works will consume in a year would heat half the homes in Philadelphia. In addition, millions of gallons of fuel oil will be burned, as well as enormous volumes of gas produced in the plant.

It takes around 150 tons of water to manufacture a ton of steel products, and the Fairless Works will circulate approximately 230 million gallons daily. Up to 21,000 gpm will be required at the hot-strip mill to cool the rolls and steel, to descale the product and to operate the hydraulic machinery that will manipulate the slabs during rolling. Each blast furnace will use some 18,000,000 gallons for cooling purposes every 24 hours.

The water will come from three sources. The bigger portion, for cooling generally, will be pumped directly from the Delaware. About 8000 gpm will be drawn from shallow wells and will consist of water that has percolated from the river through subsurface sands. It will be employed mainly for cooling during the steel-finishing processes. Water for drinking and sanitary purposes will be obtained from deep wells. Fifty acres will be given over to a plant for treating process water before it is used and again after it has been used and before its discharge into the river. Because of the volume obtained from wells, more water will be returned to the stream than is taken from it.

Although steel mills are commonly supposed to contribute smoke and soot to the atmosphere, the people of the area have been assured that the Fairless Works will not do that. The blast furnaces will be equipped with dust catchers and electric precipitators. The fine iron dust thus retrieved will be melted, and the gas from which it is separated will serve as fuel. The open-hearth furnaces also will be provided with dust collectors. The coke ovens, of which there will be two batteries of 87 ovens each, will be designed to trap the gases in order that they may be processed to recover numerous chemicals that are the starting point for the manufacture of valuable products ranging from moth balls to nylon. The residue gas will be burned as fuel. Even the locomotives will not exhaust smoke because they will be of the diesel type.




## STOCKPILING

TWO global conflicts within the past half century have proved that modern warfare is waged as much behind the scenes as on the fields of combat. Success at the battle line hinges largely on the effective functioning of production lines back home. In Napoleon's day an army traveled on its stomach; now it must have adequate supplies of many things other than food. Any nation faced with the necessity of defending itself successfully against an aggressor must stock not only its larder but its countless warehouses as well. In these storage depots must be big supplies of varied materials ranging from feathers to wool, from bauxite to tungsten.

For some months past, Uncle Sam has been diligently accumulating things we do not produce at all or in quantities too small to serve our needs if we should be drawn into a war. This stockpiling program is intended to do more than strengthen the sinews of war; the object is also to provide essential materials to meet civilian requirements under a wartime economy. All told, 73 items are on the shopping list, and to get them we have been combing the Seven Seas. We get rubber from Indonesia, talc from Sardinia, cobalt from Canada, tungsten from half a dozen nations and so on.

A report of the Munitions Board shows that up to June 30 we had received materials valued at three billion dollars and had contracted to obtain an additional 1.9 billion dollars worth. This total, however, is far short of our goal, which now stands at 8.3 billions. Before the objective is reached it may be extended. These diversified goods are being stored at 210 locations. The actual facilities may vary from a vault for the safekeeping of precious minerals and narcotics to an open, unguarded dump for ores of base metals.

The goods are ostensibly being stockpiled for withdrawal in the event of war, but the rule on this is not mandatory. If some of them seem to be needed right now in production channels, they are diverted to them in sufficient amounts to meet the current demand. Charles E. Wilson, head of the Office of Defense Mobilization, has the final say regarding them.

Suppose there is no war in the immediate future. What happens to the stockpiles then? Nothing, if those who are guiding our defense preparations have their way. They believe the knowledge that we have an adequate supply of everything we would need to wage war and to sustain overpopulation at home during a war would be a great influence for preserving the peace.

## FLOODED AREAS REBOUND

TO THE volumes that have been written about America's productive capacity, something should be added concerning the nation's recuperative powers. Stricken by paralyzing floods that stopped all transportation and commerce, the Kansas-Missouri area snapped back with surprising speed. Although water as deep as 22 feet covered large sections of the industrial district of Kansas City, Mo., on July 13, more than 100 firms that manufacture products ranging from biscuits to heavy machinery were doing business "almost as usual" by August 4.

Some concerns resumed operations fifteen days after the flood hit; others required a longer time to get going. Actually, hordes of workers were tackling the herculean clean-up job only nine days after the peak of the inundation, and some production operations were put underway almost immediately. Within two weeks 23,000 industrial workers were back on their regular jobs.

Three weeks after the waters reached their peak, 90 percent of the scheduled passenger trains were running, an even hundred of the 137 truck lines serving the area were functioning, and all airline flights were operating. Wheat began moving into this breadbasket of America less than two weeks after the climax of the disaster, and 679 carloads reached Kansas City the first day. Two of the big packing houses resumed beef slaughtering within three weeks.

To let the world know that it was making a quick recovery and would be back to normal shortly, Kansas City organized a Flood Information Committee. Its headquarters handled all inquiries from the outside and was able to give information as to when different industries would be able to fill orders. Nine conventions scheduled for the city during August were held, and in only two cases was it necessary to set the dates ahead.

There was great human suffering and privation, and many families lost their all. Many individuals will be years in getting back on their feet and some will never regain what they have lost. But corporate business enterprises will be rid of their scars in an unbelievably short time. Here, again, is recorded a triumph for America's free-enterprise system.

## EXEUNT HIGHGRADERS

ONE of the unexpected benefits of atom-splitting may be the eradication of highgrading, as the theft of ore from mines is termed. If this should transpire, science would chalk up a victory where mine owners have always met defeat.

Nobody knows when ore stealing began, but it was a long time ago. Perhaps some of the slaves who worked in King Solomon's mines occasionally secreted rich gold specimens about their persons and disposed of them surreptitiously. Ore was likewise purloined in the Saxon mines of medieval times, but highgrading reached its peak when the American western gold-mining camps were in their heyday. It thrived because illicit assayers provided outlets for the ill-gotten spoils that were carried out of the workings in lunch buckets, shoes, and even under the tongues of miners. Cripple Creek, Colo., at one time had as many as 35 assayers, about six times more than the camp needed in order to take care of its legitimate business.

The change system under which miners leave their working clothes on company property whenever they come off shift was instituted largely for the purpose of thwarting the efforts of the pilferers. An estimate that from 10 to 15 million dollars worth of gold is stolen annually from Canadian mines and mills was made recently, and it is from that country that the suggestion for ending the practice has come.

The scheme is a remarkably simple one that looks to be sure fire. Each mine or mill would add to its product a small amount of some inexpensive radioactive tracer material. The various producers would have their own distinctive isotopes, or would use a definite concentration. In either case, the dosage would constitute a "fingerprint" that would show where any lot of ore, concentrate or refined gold originated. Persons suspected of transporting or trafficking in "hot" gold could be "searched" with a Geiger counter. Governments, probably through their mints, could administer the plan, allotting radioactive "detectives" to only authorized gold shippers.

# This and That

**What's in a Name?**

Many persons can remember when machinery in this country was named for people. Railroad locomotives sometimes bore men's names on their sides, and stationary machines of various kinds, including air compressors, were occasionally similarly adorned. Company officials or other individuals who had played prominent parts in the organizations concerned were usually singled out for such honors.

In Syria today the custom is being reversed, according to a dispatch from Damascus in the *New York Times*. Farm machinery has only recently been introduced in the cultivation of cotton, and large growers have begun to use pumps along the Euphrates and its tributaries for irrigation. These are held in such awe by the natives that they christen their children for them. Thus, a boy may be named Mohammed Consolidated Pumps Incorporated.

★ ★ ★

**British Tunneling Record**

A British record for advancing small-bore tunnels was established recently, according to *The Engineer*, of London. Through diorite of the Cobbler Range, crews drove a 7-foot-square heading 427 feet in seven days of round-the-clock work. The mark was set by forces of Edmund Nuttall, Sons & Company (London), Ltd., on a collecting aqueduct for the Loch Sloy hydroelectric system of the North of Scotland Hydro-Electric Board. This is said to be the first time more than 400 feet of rock tunnel was driven in a week in the British Isles. The previous top figure of 334 feet was made recently in the Bowland Forest Tunnel of the Manchester Corporation's waterworks scheme. The best progress in one month at Loch Sloy was 1231 feet.

★ ★ ★

**New Aid for Well Drillers**

The use of compressed air instead of mud circulated to remove rock cuttings while drilling holes for detonating explosives in oilfield geophysical prospecting was described in our January, 1951, issue. The same technique, it is stated in *World Oil* for August, has been successfully employed in drilling gas wells with standard rotary tools in the Blanco Field of northwestern New Mexico. However, because natural gas is plentiful there, it is substituted for air. The conventional method of circulating mud in the hole is unsatisfactory when completing a well because a great deal of it is lost in the porous formation. Gas not only overcomes this difficulty but has, in addition, increased drilling efficiency. The daily footage has been increased from a maximum of 200 to 700 or more, and a bit that averaged 80 feet of hole with mud is now good for from 300 to 400 feet.

★ ★ ★

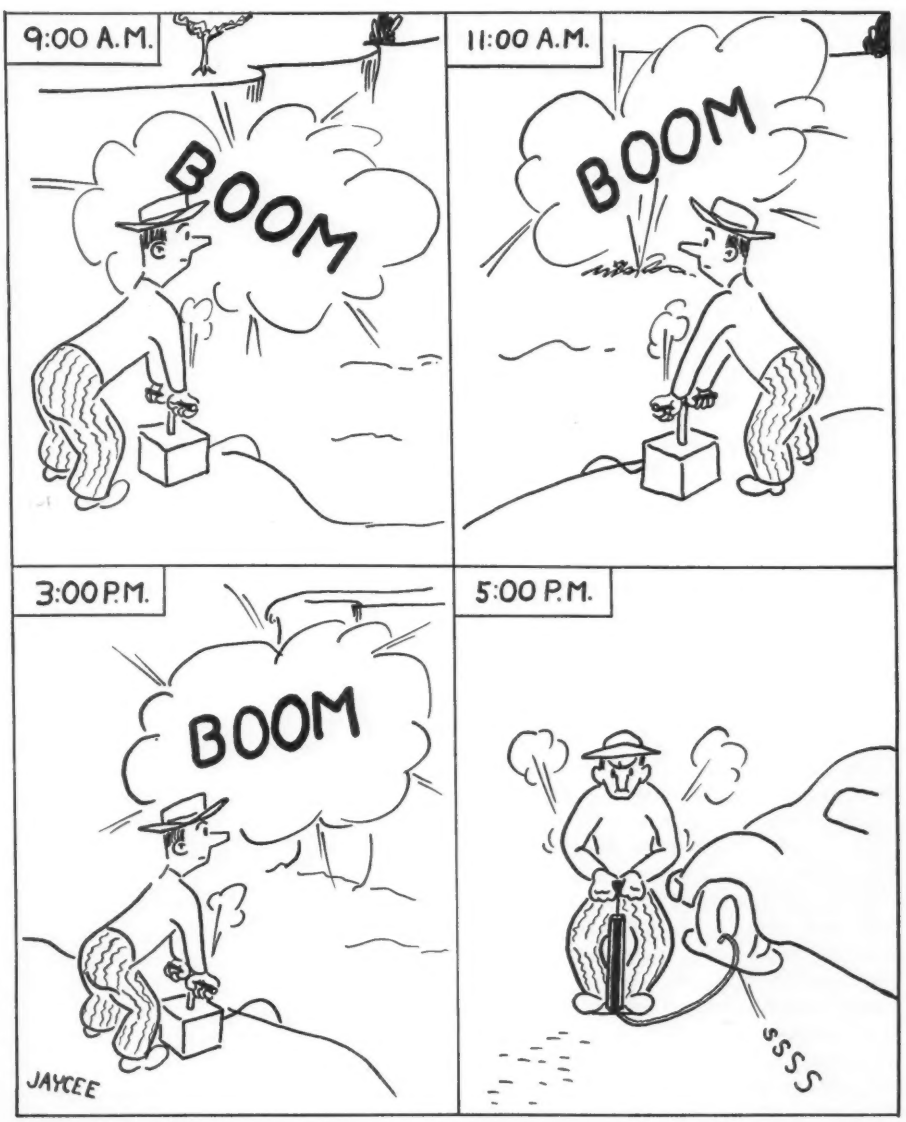
**Blasts Kill Fish**

Geophysical exploration for oil involving the use of explosives off the coast of California was forbidden in August, 1949, because a considerable number of fish was being destroyed. Experiments conducted since then by the Union Oil Company and the Scripps Institute of Oceanography have revealed that little damage is done to marine life when black powder is substituted for dynamite. As a result, the California Fish and Game Commission has agreed to permit the resumption of seismic prospecting this month. The kill rarely exceeded the total of fish taken in a day by a single commercial fishing vessel, according to the oil companies concerned, but operations were nevertheless restricted and it was ruled in 1948 that interested concerns must conduct their operations jointly. This was done with from three to eighteen participants until a day in August, 1949, when an exceptionally large number of fish was killed. It was then that the practice was banned.

★ ★ ★

**Factory Drills for Gas**

Few factories have a source of fuel on their own property, but Sharon Steel Corporation may be in that category and intends to find out. Drilling was begun the last week in July on a farm adjoining the firm's Roemer Works at Farrell, Pa., with the hope of striking natural gas at a depth of around 3800 feet. Geologists believe that there are three possible gas-bearing formations under the property. Oil and gas was withdrawn from around 700 feet at one time, but the wells were



abandoned 30 years ago. Today, the nearest gas production is 15 miles away. At present the factory operates on natural gas that is piped in and fuel oil that is hauled in.

★ ★ ★

**Less Cobalt Used**

Cobalt, which has been in short supply, is now being used at a lower rate than at any time during the past fifteen months, according to the Defense Production Administration. First-quarter consumption this year was 2,322,820 pounds, a decline of around 17 percent from the fourth quarter of 1950 when consumption broke all records. Domestic output of cobalt, on the other hand, rose 8 percent in the initial quarter of this year, and imports were up 62 percent. The only current producer of cobalt in this country is Bethlehem Steel Company, which obtains it as a by-product in the iron ore it mines at Cornwall in eastern Pennsylvania. Cobalt has numerous industrial applications, but most of it is now going into alloys that are important in the defense program. The metal also enters into tungsten-carbide inserts for rock-drilling bits that are used in producing numerous strategic minerals.

★ ★ ★

**Sweden Rich in Iron Ore**

While American steel companies are now going as far as South America for some of their iron ore and contemplating the day when high-grade domestic deposits will be exhausted, Sweden finds herself comfortably fixed with rich ores for a long time to come. According to Dr. Per Geijer, retiring head of the nation's geological survey, those in the northern part of the country will last for at least two centuries at the present rate of mining, and large deposits also are available in the central section. He thinks additional low-grade ores may be discovered, but is doubtful if much more rich ore will be found.

★ ★ ★

**Stockholm Extends Subway**

Stockholm, Sweden, a city of nearly a million inhabitants, is extending its subway system to help relieve transport difficulties. The initial underground line was built in 1933 to serve the southern suburbs and, until 1950, operated ordinary street cars. Next came a section for the western outlying areas. Both of these links run above ground except in the business district. Since 1945 an additional 2.3 miles has been under construction in the heart of the city. About one-third of it had to be tunneled through solid rock, and this work, which involved the underpinning of many adjacent buildings, was completed by 1949. The Stockholm School of Economics had sunk one inch and was restored to its original level by jacking. The Concert Hall, resting on fine gravel and sand, was strengthened by injecting a mixture of water glass and calcium chloride into its supporting ground area.

When the west-south lines have been hooked up there will be nine underground stations, the largest of which is being designed to handle 60 million passengers a year. Most stations will have intermediate levels that will house shops. Walls will be of one-color tile and lighting will be with fluorescent tubes. Concrete pillars will be polished to bring out the luster and pattern of specially selected pebbles in the mix. Cars will have capacities of from 140 to 160 riders and eight will make up a normal train. Maximum speed will be approximately 44 miles per hour, and during rush periods trains will run 1½ minutes apart.

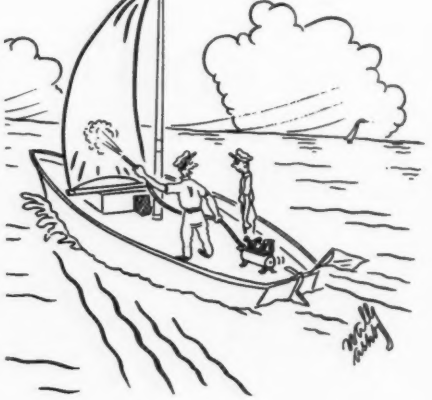
★ ★ ★

**Inexpensive Underground Ventilation**

A recent U.S. Bureau of Mines report tells how a portable air compressor was successfully used to ventilate a mile-long mine adit for several weeks. The Geological Survey, which was making a study of the Tenmile mining district in Summit County, Colo., wanted to examine the workings of the inactive King Solomon Mine but found that the air 700 feet in from the portal would not support life.

The cost of setting up a ventilating fan, pipe and other equipment and of making a power connection was considered prohibitive for temporary service, so it was decided to determine whether an air compressor would do the job. A 5-man crew and a burro were hired to haul 2-inch pipe into the adit and put it together. The installation was completed on August 31, 1950, and the engineers were supplied with air for three weeks. The expense, except that of moving the compressor and pipe to and from the site, amounted to $1,536.09. After detailing the methods utilized, the report concludes:

"Long adits and other underground workings having only one surface outlet can be ventilated with a relatively small volume of compressed air, provided the underground atmosphere consists of air deficient in oxygen only and does not contain concentrates of carbon dioxide or other gases difficult to dilute or remove; also provided the time element involved in ventilating the workings is not too essential."



"Well, there isn't any breeze, and this is working, isn't it?"

★ ★ ★

**California Gold Mine Sues U. S.**

The Idaho-Maryland Mines Corporation of California has brought suit against the U. S. Government for damages allegedly sustained from the enforced wartime shutdown of its gold-mining properties under the provisions of Limitation Order No. L-208. As a result of the inactivity from October, 1942, on, the expense of maintaining the mines, and the cost of restoring them to production, the concern claims that it has lost $5,021,799 and asks repayment of that sum, together with interest from July 1, 1945.

Prewar profits of Idaho-Maryland ranged as high as $1,124,000 in 1937, and the payroll numbered nearly 900 men in 1940. For the first half of this year the profit amounted to $6820. Outcome of the suit will be watched with interest by other American gold-mining companies that were obliged to suspend operations during the war and that have had a great deal of difficulty in resuming profitable work.

★ ★ ★

**Abrasive Sprayed in Water**

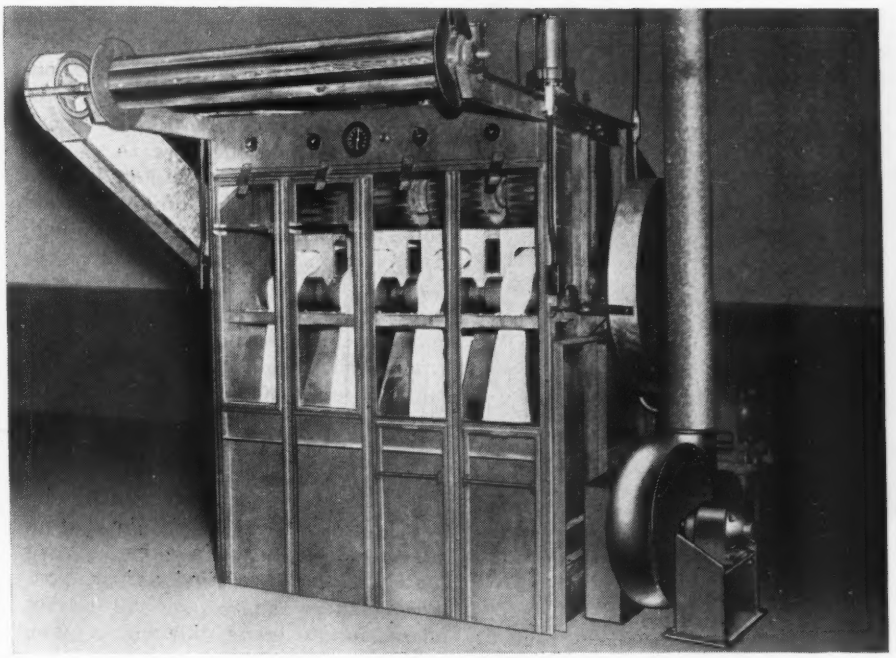
Fine abrasive dust suspended in water and sprayed by high-pressure air will produce high finishes on both metallic and nonmetallic products, according to Pangborn Corporation. Impact of the abrasive, some of which is as fine as talcum powder, removes minute amounts of material from the surface blasted. Actually, it is claimed, millions of microscopic pockets are formed, and on working surfaces these hold oil and improve the operation and life of the part. Machines embodying the new technique have been built to remove heat-treat scale from up to 700 automotive piston rings and pinion gears an hour.

# Crusher Removes Carbon from Cloth

IN our February issue we had a short article on carbonizing woolen cloth by running it through an acid-soaking tank of an improved type, a drier and a baker to convert the contained vegetable matter into carbon. Since that time, Riggs & Lombard have announced another piece of finishing equipment that takes up where the baker leaves off and is said to do its work twice as fast and better than the old-style model. It's a semi-continuous crusher through which the carbonized fabric is run to remove the carbon, work known in the trade as "dusting."

The machine has four identical compartments, each with a pressure roll on top and a driving roll at the bottom. As the cloth comes from the baker, it is put into the compartments, one piece in each with the ends sewed together to form a continuous rope. Mounted on top of the crusher are four air cylinders which both lower and lift the upper rolls and force them down upon the material. Under the pressure of the top rolls, which are fluted to exert a crushing action, the carbon particles in the fabric are reduced to dust as it travels round and round at the rate of nearly 300 yards per minute. This high speed throws the cloth against the back of the machine with such force that it shakes out the dust, leaving the fabric exceptionally clean. The dust is continually removed by a built-in exhaust system with integral ducts and a motor-driven fan.

Each compartment can be loaded or unloaded without stopping the others simply by raising the top roll. With the pressure thus released, the material comes to a halt, permitting its removal and the substitution of another piece. The air-cylinders are under fingertip control and, by regulating the pressure, make it possible to run four different fabrics, each requiring a different crushing pressure, through the machine at the same time with equally satisfactory results.



**"DUSTS" WOOLENS**

The motor-driven semicontinuous crusher showing the four separate compartments loaded with cloth, the exhaust system (right), and one of the air cylinders that apply pressure to the fabric through the top rolls and also serve to lower and lift these rollers. Each cylinder can be operated and controlled separately from the front panel of the machine so that different kinds of cloth can be handled at one time and the pressure varied to meet their needs.

## Nickel Company Forsakes Open Pits

IT IS not unusual for mining companies to convert from underground to open-pit operations and thus increase production. Surface mining with power shovels, truck and rail transportation, and its other inherent features is conducive to low-cost, high-tonnage extraction. The mining world may therefore be surprised to learn that a major company is going completely underground from a combination pit-underground operation and stepping up tonnage appreciably as a result.

The International Nickel Company of Canada, Limited, is doing just that, but it is being forced underground because its great Frood-Stobie open pit, producer of millions of tons of nickel ore, is approaching exhaustion. Inco is planning to hoist its entire output of 13,000,000 tons of ore in 1953, as compared to 5,700,000 tons from below ground plus 4,100,000 tons from open pits in 1950. The change is being made without interrupting current output because a major program for the expansion of the underground mining capacity was initiated by the company ten years ago.

Improvements in metallurgical processes and the installation of emergency facilities were included in the program, which has involved the expenditure of around $100,000,000. Results will not be fully realized for about two years, but they are already being felt. An increase of one million pounds of nickel monthly over the 1950 rate was achieved in July of this year and brought monthly production of refined nickel to 21 million pounds—the company's highest peacetime rate.

---

The U.S. Bureau of Mines has awarded a contract to the Chemical Plants Division of Blaw-Knox Company for the design and construction at Rifle, Colo., of an experimental plant for the continuous extraction of oil from shale. To cost approximately $333,000, it will be based upon a new gas-combustion retorting method developed by the bureau and will process anywhere from 150 to 400 tons of oil shale daily.

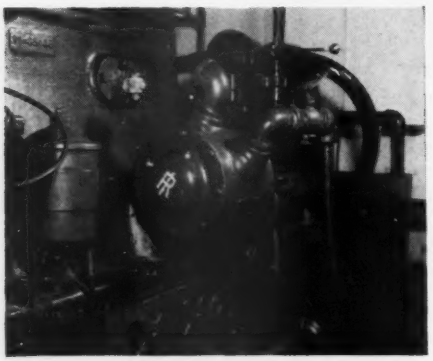
## Ropes Serviced in Motion

BY A METHOD developed at the Homestake under the direction of Josiah Gerrans, chief mechanical engineer, all the mine's hoisting ropes are lubricated while they are in motion. The idea is not new, but as applied at the Homestake is said to work effectively. Each rope is first cleaned by compressed air, and is then oiled by means of four spray guns mounted at equidistant points around the rope. Both the lubricant and the air for the guns are heated to about 170°F in a steam heat exchanger. The lubricant enters the exchanger at the top and passes through a 10-inch jacketed pipe section, while the air is introduced at the bottom and flows through a coil.

A light, medium lubricant is used for all except the 150 feet of rope near the cage or skip. This end is given a heavier kind, and it is sometimes necessary to use dry steam as well as compressed air to clean it. Work on the latter section is not done on the day the main rope is being serviced. Each rope is lubricated throughout its entire length every ten days, and the new equipment makes it possible to take care of two in about twenty minutes.

# Industrial Notes

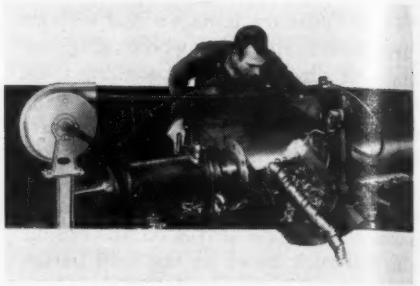
For cranking diesel and gasoline engines with piston displacements up to 3500 cubic inches and more, Ingersoll-Rand Company has developed a line of air starting motors that has a wide field of application in heavy industries including construction, lumbering and mining and in the trucking, petroleum, power and marine fields. The power unit consists of a Multi-Vane air motor with a solid-steel rotor revolving in a cylinder of wear-resistant alloy and enclosed by bronze end plates. The rotor has five vanes for smooth power flow, and ball bearings are used to support all rotating parts to insure long life and trouble-free service. Cranking is said to be reliable and accomplished through a conventional Bendix drive that is engineered to the performance characteristics of the motor. Any mechanic familiar with the maintenance of internal-combustion engines can service and install the unit. Ordinarily powered by compressed air, equal performance is assured when operated with natural gas if available at sufficient pressure. Two basic sizes are furnished: 9-BM and 20-BM which, respectively, develop up to 16 and 41 hp and require approximately 7 and 16 cfm of air per start. The company makes nine models for adaptation to many different engines.



**MARINE INSTALLATION**

Shown at the right-center is a Size 20-BM air starting motor serving a Buda engine aboard the tug "Captain George." The use of generators, banks of batteries, and electrical accessories such as solenoids and voltage regulators with their high maintenance and replacement costs are eliminated.

Coils of hose lying around loose or draped from overhead are a hazard that is avoidable by the use of retriever hose reels such as are made by The Wayne Pump Company for general industrial use, garages and service stations. Open and enclosed types are available for water, coolant, air, oil or grease hose ranging from a ¼-inch (inside diameter) 15-foot line to ½-inch high-pressure hose 50 feet long. The latest models have a stainless-steel shaft and a newly designed swivel assembly with oil-impregnated bronze bearings and an "O" ring seal. The reel is actuated by a powerful spring, and the hose is held at any desired length until a rotary latch is released by a short pull, which causes it to rewind. Whip, lash, or runaway is prevented by a governor that automatically controls the return speed, and a rubber bumper on the coupling brings the hose to a cushioned stop. A universal mounting bracket permits installing reels on floor, ceiling, wall or column, above or under a bench, wherever most convenient. For servicing trucks and cars with water and air there is a Twin Reel Pit housed in a steel box that can be set flush with the pump island; and in another reel designed for refueling airplanes, for example, provision is made to prevent the accumulation of a dangerous static charge.



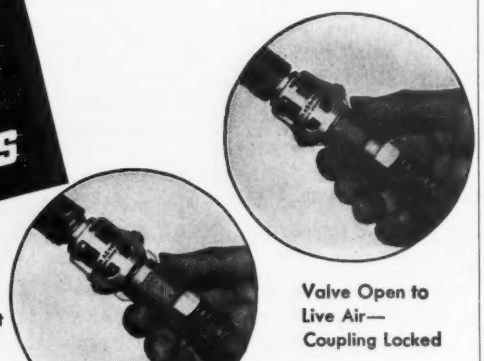
**MACHINE-TOOL APPLICATION**

This picture shows the retriever hose reel attached to a lathe and supplying coolant to the cutting-tool head. The liquid is fed through the reel to the hose, which follows the movement of the head and leaves no loops in the way to cause accidents.

Vermiculite, which is used in making plasters and boards for insulation against heat, cold and sound, is being applied in a novel way by a fabricator on the West Coast. During periods of nonproduction such as week ends and holidays, a 4-inch layer of the lightweight mineral is put on top of the molten zinc in 60-ton galvanizing kettles and 20 of the 32 gas burners are turned off. In this way a lot of fuel is saved and the metal is kept at the desired temperature. The blanket costs little, because it can be scraped off and reused.

Clearing timberlands by a single saw at the rate of five acres in an 8-hour day where the stands are dense and ten acres where light, sounds fantastic, but that is being done, we are told, by a group of contractors on the U.S. Bureau of Reclamation's Boysen Dam Project. This


Quick-As-Wink
AIR AND HYDRAULIC
Control Valves



Valve Closed to Live Air— Open to Exhaust

Valve Open to Live Air— Coupling Locked

VALVE COUPLINGS ¼", ⅜", ½", & ¾" SIZES

For Economy and Safety

● These couplings permit air to be shut off and tools changed quickly without going to the main shut-off valve. Coupling jaws are automatically self-locking when valve is open to air supply. The coupling cannot be disconnected until the valve sleeve is moved to closed and exhaust position,— thus preventing accidents and injuries. Pressures to 250 p.s.i.—hose shank, male or female pipe connections. *Send for Bulletin No. 104-C. It gives full details and prices.*

THE HIGHER THE PRESSURE THE TIGHTER THE SEAL

Quick-As-Wink
AIR AND HYDRAULIC
Control Valves

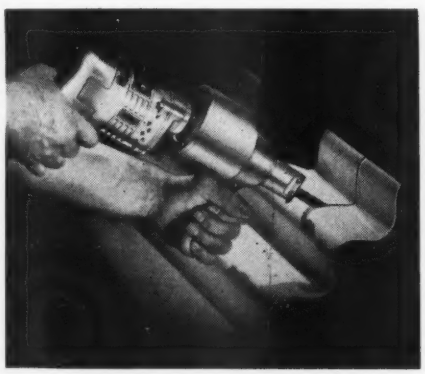
*Hand, Foot, Cam, Pilot, Diaphragm and Solenoid Operated*

**Mfd. by C. B. HUNT & SON, INC., 2036 East Pershing St., Salem, Ohio**

herculean performance is attributed to a 6-foot-long saw bolted to the blade of a bulldozer. With its flat, V-shaped, toothed steel plate and central stiffening rib tapering from front to back, it looks much like the head of a sawfish. Guiding his bulldozer so that the tip of the cutting edge strikes the tree, the operator drives the machine ahead to force the saw through the trunk, felling cottonwoods as much as 24 inches in diameter in one pass. A heavy steel frame protects the operator from falling timber. The saw is set close to the ground to make a clean cut, and the teeth are fine or coarse to meet varying needs. Another bulldozer, fitted with a heavy rake whose tines extend 8 inches below the blade, clears away the trees and underbrush.

---

Maintenance and repair men, plumbers, carpenters, and production men generally have at their disposal a new hand tool, the E-Z Saw, that is designed to lighten their labors while speeding up operations. It is attached directly to an air or electric drill or a flexible shaft and converts the rotary action of the power unit into a fast reciprocating motion. The tool can be used either as a saw or a file by inserting an ordinary hacksaw or

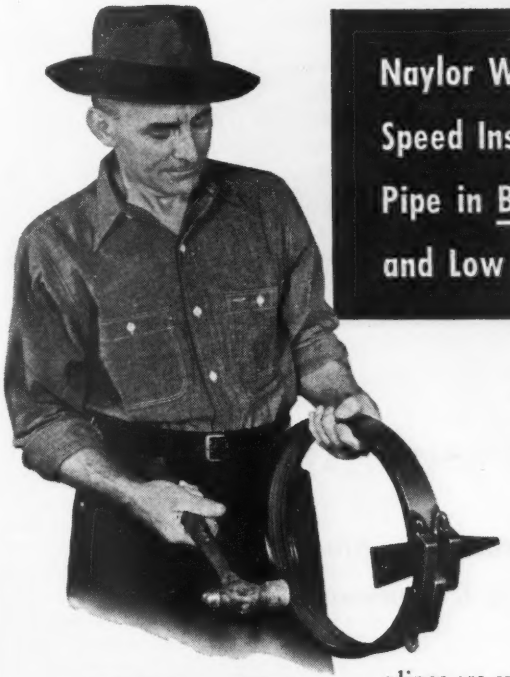


a machine file into the holder and operates with a 7/8-inch stroke. A full-length cutting blade can be used to reach hard-to-get-at places, and special blades are available for very heavy work. The handle is adjustable—can be turned and locked in any desired position. According to the E-Z Way Tool Company, the saw quickly cuts through all metals, including corrugated stock, as well as wood, plastics, and other materials.

---

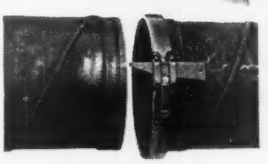
By a new method of descaling forgings, which eliminates sandblasting, it is possible to effect savings up to 90 percent, says the Pennsylvania Salt Manufacturing Company, which is responsible for the new treatment. The concern has prepared a compound called Pennsalt SR-4 that is mixed with weak muriatic acid and water. The forging, placed in a sheet-iron basket, is immersed in the solution for five minutes, heat-treated, and then dipped in water. There, according to reports, the oxide

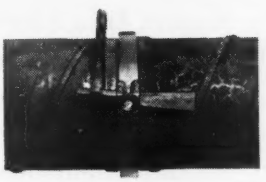

# *Short Cut to Pipe Connections*

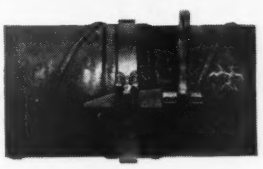


**Naylor Wedge-Lock Couplings Speed Installation of Naylor Pipe in Both Heavy-Duty and Low Pressure Service**

Whether it's a permanent, heavy-duty installation, or a temporary, low-pressure line, there's a Naylor Wedge-Lock Coupling that's ideal for connecting Naylor pipe.







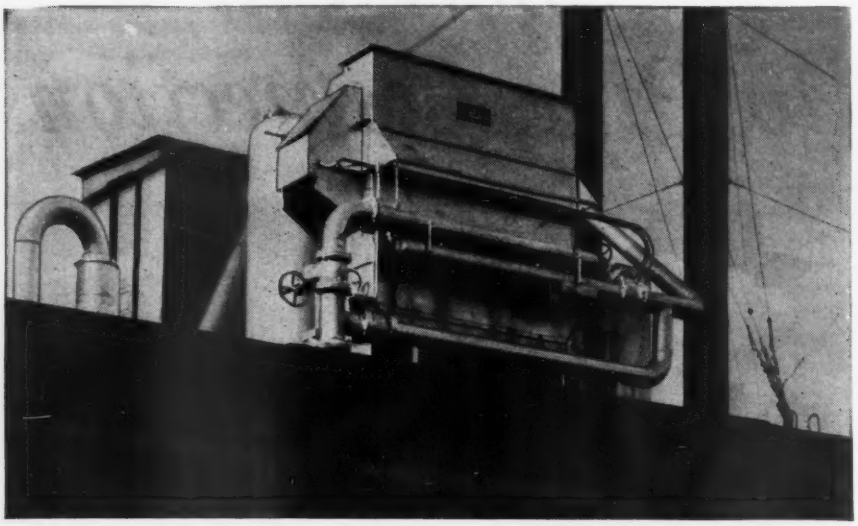
These positive type couplings are available in two types—for heavy duty and for low pressure. They provide the quickest, easiest and most economical method of pipe assembly, and a hammer is the only tool required.

The Naylor Wedge-Lock one-piece construction offers definite advantages. Joints can be made up with only one side of the line in the open. The coupling also provides for expansion and contraction. It assures tight, leakfree joints, less power loss, long service life, high salvage and re-use value. Available in sizes for light-weight pipe from 8" to 30" in diameter.

**Write for Bulletin No. 513 on Heavy-Duty type; or Bulletin No. 514 for Low-Pressure Coupling.**

**NAYLOR PIPE COMPANY**
1245 East 92nd Street, Chicago 19, Illinois
New York Office: 350 Madison Avenue, New York 17, N. Y.

***Direct saving of cooling water expense returns to you the cost of a Niagara Aero After Cooler in less than two years.***



# How to Get Drier Compressed Air:

***It prevents many troubles and saves much expense***

● NIAGARA AERO AFTER COOLER cools compressed air or gas below the temperature of the surrounding atmosphere. Therefore you get no further condensation in your lines. You save much in repairs to pneumatic tools and equipment; you save much interruption to production; you save water damage in paint spraying, in air cleaning, in any process where compressed air comes in contact with your materials or parts in manufacturing (sand blasting, for example).

Niagara Aero After Cooler uses evaporative cooling, saving 95% of your cooling water consumption. This saving quickly returns the cost of the equipment to the owner or makes extra cooling water available for other processes.

The Niagara Aero After Cooler produces compressed air with 30% to 50% less moisture than by ordinary cooling methods. Other Niagara equipment provides bone-dry air for processes requiring it.

If you have an air problem or a cooling problem, a Niagara engineer probably has an answer that will improve your process or save you operating or maintenance expense.

*Write for Bulletin 98*

**NIAGARA BLOWER COMPANY**

Over 35 Years Service in Industrial Air Engineering

**Dept. CA, 405 Lexington Ave. New York 17, N. Y.**

*Experienced District Engineers in all Principal Cities*

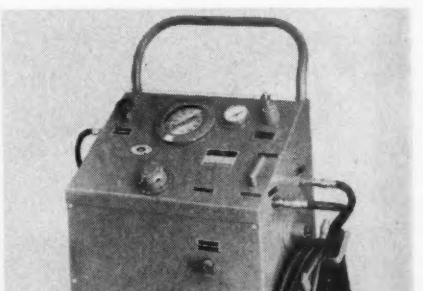
scales fairly shoot away from the steel, leaving the surfaces clean for machining. The process has been used satisfactorily on grades of carbon steel and some alloy steels.

---

Repairs to holes or breaks in concrete floors can be made quickly during working hours, it is claimed, by a new quick-setting cement called Por-Rok. Mixed with water, it is poured into cleaned-out openings and requires no troweling. According to the maker, The Hallemite Manufacturing Company, the patches are ready for light loads in fifteen minutes and for the heaviest kind of loads within an hour. The material has a compression strength of 4500 psi.

---

Though designed primarily for use in connection with aircraft, Sprague Engineering & Sales' new hydraulic power unit is suitable for testing all types of hydraulic components and systems within its capacity range of 500-5000 psi. A pneumatic boost pump taking air from a plant line supplies the energy to operate the apparatus, which can be wheeled right to an airplane for operational or static testing, or anywhere in a factory for checking components on the spot,

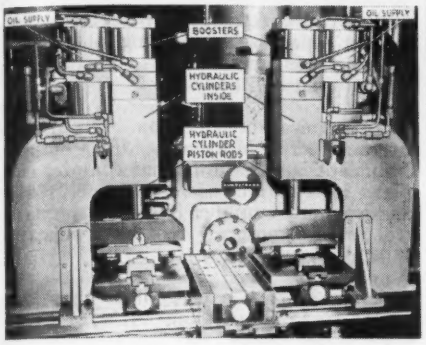


thus eliminating the use of expensive stationary stands that disrupt normal volume-inspection schedules. Known as the Model S-404, it comes complete with instruments and controls and is available with a single or a double hose outlet. The unit is housed in a steel cabinet mounted on rubber-tired wheels.

---

Ease of operation and time and labor saving are advantages claimed for a universal-type clamping fixture built especially by the Planet Products Corporation for the Sundstrand Rigidmil, which handles work pieces ranging from approximately 2 inches square and 1 inch thick to 20 inches square and 5 inches thick. The fixture, which is actually two clamping units facing each other, is designed for the reciprocal milling of two

small parts or one large part, which is kept level automatically through contact between a serrated reaction shoe and a mating reaction plate. Each half consists of a Miller Air Miser fluid pressure booster with a ratio of 25 to 1, of a Miller high-pressure (2000-3500 psi) hydraulic cylinder, of an oil-supply tank and of an on-off switch. When the latter is moved to the "on" position, compressed air




from the shop line is admitting into the tank, forcing the oil through the booster by-pass into the hydraulic cylinder, giving the piston a low-pressure stroke. As soon as the piston is in contact with the workpiece, the high-pressure oil from the booster is automatically cut into the system and provides the clamping pressure needed to hold the work during the milling operation. With input air at 80 psi, a total clamping force of 10,000 psi is obtained. This can be varied as desired by lowering or increasing the air pressure.

---

Although titanium is one of the earth's most abundant elements, it has not been available in large quantities because it is difficult to extract. However, production has grown from a few laboratory samples in 1946 to 550,000 pounds in 1950. There also is a possibility that the price may be reduced from the present $5 to $7 a pound to $1, according to a report from Horizons Titanium Corporation, a new organization. The latter has been experimenting with a continuous rather than a batch process of making the metal and is now ready to proceed to the pilot-plant stage.

---

Some time ago National Tube Company began a research program with the aim of providing steel casing that would be strong and tough enough to withstand the great pressures to which it is subjected at the ever-increasing depth to which oil wells are being carried. The result is a quenched and drawn carbon-manganese steel which, in the case of 7-inch casing (outside diameter), is said to have a minimum yield strength of 110,000 psi at 0.6 percent total strain, an average ultimate strength of 139,000 psi, and an average elongation of 22.4 percent in 2 inches. The improved casing is in production at the company's McKeesport, Pa., plant.


WORLD'S BEST METHOD FOR PIPING

The Victaulic name stands for pioneering and world leadership in quick, dependable piping construction. Victaulic offers a *complete method* of piping that just can't be beat! From one end of the line to the other... for almost every kind of piping job... you'll find that Victaulic's the EASIEST WAY TO MAKE ENDS MEET!

Victaulic is *not* just a quick way to hook up pipe line sections... it's a COMPLETE METHOD with a versatile line of Couplings, Full-Flow Elbows, Tees, and other Fittings. Victaulic offers wide adaptability and makes joining those pipe ends quick, easy, and economical. A simple two-bolt coupling brings pipe ends together in a jiffy; a speed or T-wrench is the only tool required. AND the Victaulic Method assures positive-locked, leak-proof joints even under extreme pressure, vacuum, or strain conditions.

Preparing pipe ends is a cinch with the "Vic" Method..."Vic-Groover" grooves 'em automatically, twice as fast as a conventional pipe threader!

On *your* next piping job — new construction, repairs, or alterations — try the Victaulic Method and you'll save time, work, and money!

Make that next piping job ALL VICTAULIC! Write today for Victaulic Catalog and Engineering Manual No. 44-8B

NOTE VIC'S NEW COMBINED MAIN OFFICE AND PLANT ADDRESS BELOW—

VICTAULIC COMPANY OF AMERICA
1100 Morris Avenue, Union, N. J.
Mailing Address: Box 509, Elizabeth, N. J.
Phone: Elizabeth 4-2141
Victaulic Inc., 727 W. 7th St., Los Angeles 14, Calif.
Victaulic Company of Canada, Ltd., 406 Hopewell Ave., Toronto10
For Export outside U.S. & Canada: PIPECO Couplings & Fittings, Pipe Couplings, Inc., 30 Rockefeller Plaza, New York 20, N.Y.
27TH VICTAULIC YEAR

The easiest way to make ends meet
VICTAULIC
PIPE COUPLINGS AND FITTINGS

Copyright 1951, by Victaulic Co. of America

## Books and Industrial Literature

The Heat Exchange Institute now has ready for distribution the third edition of *Standards for Barometric and Low Level Jet Condensers*. This publication covers nomenclature, types, design, performance, construction, installation and other features of these units that effect the condensation of vapors by means of direct contact with the condensing water. Calculations, data sheets and conversion tables make it a handy reference book. Published by the Heat Exchange Institute, 122 East 42nd Street, New York 17, N. Y. Price, $1.00.

Lefax announces a series of fifteen revised Dollar Data Books for engineers in the following mechanical fields: Aeronautics, No. 619; Air Conditioning, No. 638; Automotive Engineering, No. 602; Diesel Engineering, No. 640; Home Heating, No. 610; Machine Design, No. 606; Machinists' Data, No. 636; Mechanical Drawing, No. 617; Mechanics of Materials, No. 635; Metals, No. 621; Piping Data, No. 653; Power Transmission Machinery, No. 633; Steam Engineering, No. 620; Thermodynamic Tables and Charts, No. 634; and Welding Data, No. 645. All are of pocket size and contain approximately 140 loose-leaf pages of authoritative and up-to-date information. Published by Lefax, Philadelphia 7, Pa. Price $1, postpaid.

The U. S. Bureau of Reclamation has published an illustrated booklet in answer to the increasing number of requests for information from the United States and foreign countries about its Engineering Center at Denver, Colo., and the technical facilities available there. The Center maintains a library containing detailed studies of engineering problems encountered by the Bureau in its half century of planning and constructing the world's largest dams, reservoirs, hydroelectric plants and water-distribution systems. Included among its more than $2,000,000 worth of laboratory equipment is a testing machine capable of exerting a maximum pressure of 5,000,000 pounds on specimens up to 32 feet high, as well as special machinery for model making and research. The booklet tells something about the technical assistance the Center renders at cost whenever it is possible to do so without interfering with the Bureau's programs. It may be obtained from L. N. McClellan, Chief Engineer and Director, Branch of Design and Construction, Bureau of Reclamation, Denver Federal Center, Denver, Colo., or from the Commissioner of Reclamation, U. S. Department of the Interior, Washington 25, D. C.

A bulletin—No. 712—containing complete punch and shear capacity charts and detailed information on Kling punches can be obtained by writing Kling Bros. Engineering Works, 1320 N. Kostner Street, Chicago 51, Ill.

Bulletin PPY-1 distributed by Wheelco Instruments Company, 847 W. Harrison Street, Chicago 7, Ill., discusses two portable pyrometer models for plant and laboratory use and contains specifications on its thermocouple holders and tips.

Sarco Company, Inc., Empire State Building, New York 1, N.Y., has published a booklet titled *How Increasing Your Steam Costs Can Save Money*. It asks and answers sixteen questions in that vein and is written to give executives, who are not familiar with the subject, a good understanding of it.

The Armstrong Machine Works, 213 Maple Street, Three Rivers, Mich., has issued a 12-page catalogue on its steam traps and air traps. Among other features, it contains a 4-page section giving data on calculating condensate loads and selecting traps to handle the loads.

A technical booklet has been released by the Electric Machinery Mfg. Company, Minneapolis 13, Minn., that contains complete information on its magnetic drive and magnetic amplifier Regutron speed control for a-c motors. Ask for Publication 1107.

A new Morse Chain Company catalogue —No. C 55-50—dealing with its line of stock roller chains and sprockets has recently been issued and can be obtained from the company at 7601 Central Avenue, Detroit 8, Mich. The booklet includes helpful data on drive selections, service factors and installations.

"If bombs—atomic or otherwise—fall in the vicinity of your plant, what would happen? How would your employees react to the wail of the alarm siren? Would there be panic? Would machinery be left running? Could processing hazards, left unattended start destructive fires, even though bombs caused no direct plant damage?" These

FRONT VIEW shows crimping blade and adjustable heated jaws; air and thermostat controls mounted at left.
REAR VIEW shows NOPAK Model "E" 4" x 8" stroke Cylinder, with self-regulating cushion at both ends.

# Leather Crimping Machine

## *Air-Powered* by NOPAK Cylinder

**The crimping machine pictured was developed by Western Supplies Co. of St. Louis. It "makes shoes fit better" because it preforms leather upper sections, under heat and pressure, so that they can be subsequently drawn snugly against the lasts.**

**NOPAK Air Cylinder Power was chosen to reduce operator fatigue and increase production . . . to utilize controlled line pressure over the full range of crimping operations . . . to eliminate working parts . . . and because NOPAK mounting characteristics were best fitted to the machine. A study of the cylinder's construction indicated there was "practically nothing to wear out." It was also found to meet the high standards required at a comparatively low price.**

Write for Bulletin SW-1 or refer to Sweet's File for Product Designers.

NOPAK
VALVES AND CYLINDERS
DESIGNED for AIR and HYDRAULIC SERVICE

**GALLAND-HENNING MFG. CO.**
2759 S. 31st St. • Milwaukee 46, Wis.
*Representatives in Principal Cities.*

provocative questions are in a 32-page illustrated booklet on *How to Prepare Your Plant for Atomic Attack*. It is offered without cost by Walter Kidde & Company, Inc., Dept. A, 675 Main Street, Belleville 9, N.J., and serves as a guide to plant managements.

---

A 6-page folder describing vibration fatigue testers and pointing out the advantages of checking manufactured products for weaknesses in design and selecting materials for given jobs is obtainable from the All American Tool & Manufacturing Company, 1014 West Fullerton Avenue, Chicago 14, Ill.

---

The Steel & Tubes Division of Republic Steel Corporation, 224 E. 131st Street, Cleveland 8, Ohio, is offering a folder descriptive of its decoron-coated Electrunite, a new electrical metallic tubing for the protection of wiring systems that are exposed to the action of fumes, gases and other corrosives.

---

In a 30-page booklet designed as a guide in selecting electrical measuring instruments, Westinghouse Electric Corporation, Box 2099, Pittsburgh 30, Pa., explains seven basic selection factors, gives types of instruments available, and works out typical problems. The booklet, B-4696, is obtainable upon request.

---

A pictorial catalogue showing American Revolver Cranes working at docks and different industrial plants throughout the world should interest persons faced with large-scale materials-handling problems. The 19-page publication includes short job stories and can be obtained by writing to American Hoist & Derrick Company, 63 South Robert Street, St. Paul 1, Minn.

---

As an aid to manufacturers operating under the Controlled Materials Plan, Remington Rand Inc., 315 Fourth Avenue, New York 10, N. Y., has released a manual outlining methods for streamlining clerical routine and setting up and controlling records. Other functions necessary to efficient operation are also considered. Request booklet X-1203, *Record Research Report on CMP* from the Management Controls Division.

---

Those with pumping problems that involve taking water from open sources such as in dewatering, cooling tower and other bulk-liquid transfer operations will be interested in a new 8-page catalogue obtainable from Ingersoll-Rand Company, 11 Broadway, New York 4, N. Y. The booklet deals with its Class APH-APK vertical turbine-type pumps that are available in single- and multistage construction, in sizes varying from 6 to 30 inches, for capacities to 15,000 gpm, and pressures to 250 psi. Write for Catalogue 7228.

---

*How Modern Stamping Techniques Can Help Conversion* is the title of an illustrated paper presented at the Pressed Metal Institute by James M. Leake, president of The Leake Stamping Company, 1250 E. First Street, Monroe, Mich. It gives an insight into the scope of the industry and points out how manufacturers who use its products can effect speed-ups and cost savings by a better understanding of the field of "creative" metal stampings. Reprints are available if requests are written upon company letterheads.

---

A Y-type reversing cold strip mill built under license agreement by Mackintosh-Hemphill Company, Ninth and Bingham streets, Pittsburgh 3, Pa., is described in detail in an illustrated 16-page booklet, Bulletin No. 1D51, that can be obtained by anyone interested. The new mill is available in widths ranging from 16 to 66 inches or larger for cold rolling all grades of steel, brass, copper, aluminum, etc. It is said to be the first of its kind to successfully combine the advantages of small-diameter work rolls with the power required for deep draft and high speed.

---

*Gas Turbine for Gas-Pipeline Pumping* is the title of a new booklet issued by General Electric Company, Schenectady 5, N. Y. Those interested in this prime mover for centrifugal compressors will find much helpful information in the 15-page catalogue on the general features of the equipment, its application and operation. Among the numerous illustrations are charts and sketches showing the components of the turbine, horsepower limits for various ambient temperatures and typical installations. A section deals with accessories and control equipment, including remote supervisory control. Publication GEA-5530 will be mailed upon request.

---

*Stainless Steel Handbook* tabulates for easy reference the important properties of more than 30 types of stainless steel and is a handy reference work for fabricators and design engineers. Clothbound, one section of the 120-page book is devoted to the selecting of stainless for given applications, while other chapters discuss each type separately, giving specific information about heat treating, fabrication and special conditions in service. Allegheny Ludlum Steel Corporation, 2020 Oliver Building, Pittsburgh 22, Pa., will furnish the book upon request.

# $ave Power and REFRIGERATION COST

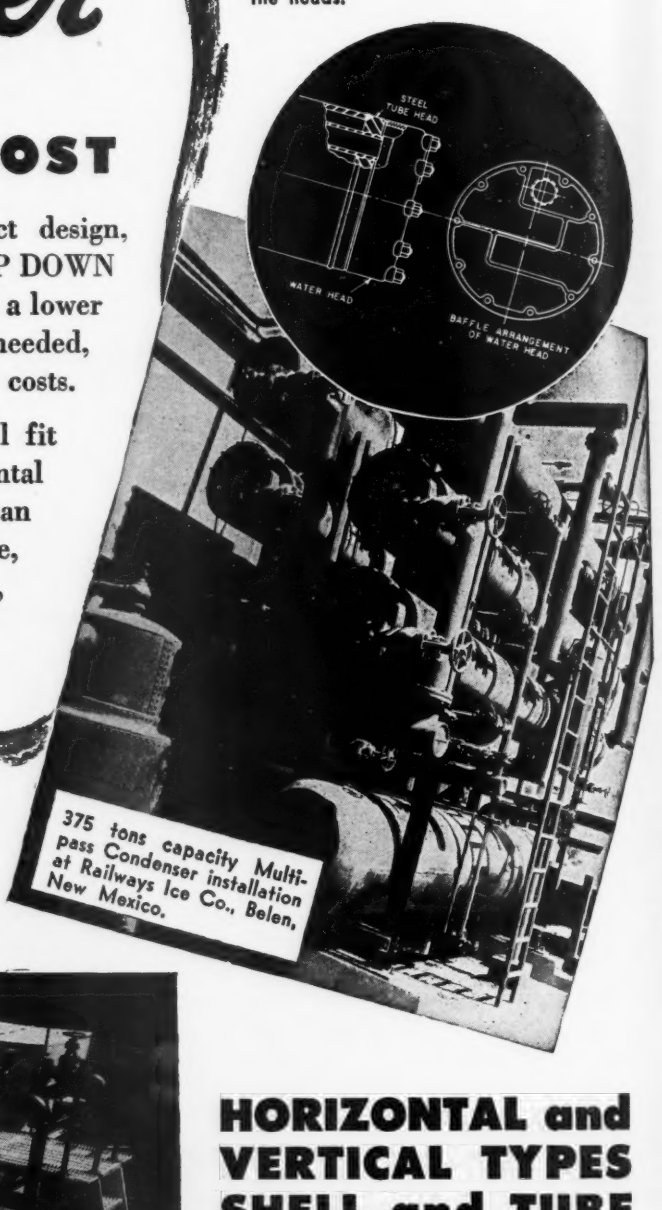
Vogt Condensers, because of their correct design, STEP UP the rate of heat transfer and STEP DOWN head pressures. With the liquid delivered at a lower temperature, smaller compressor capacity is needed, saving in original as well as operating costs.

One of the two basic types illustrated will fit your operations exactly. Install Horizontal Multipass (closed type) for use with clean waters. Where the water is hard, forms scale, contains mud or promotes fungus growth, Vertical Single Pass (film type) which can be cleaned in operation, are recommended.

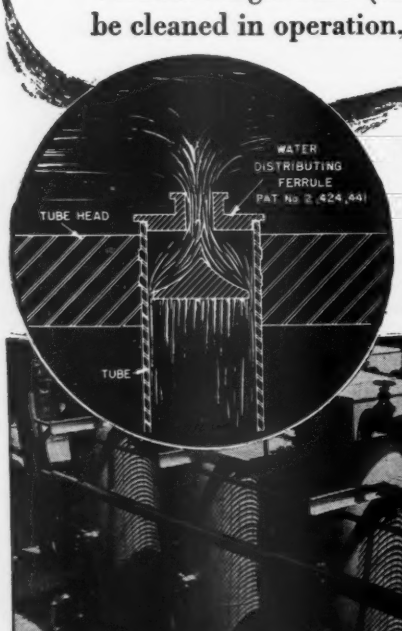
**Horizontal Multipass Condensers**
(Closed Type)

Water circulated in tubes traverses the length of the unit a number of times as determined by baffles in the heads.



375 tons capacity Multipass Condenser installation at Railways Ice Co., Belen, New Mexico.




**Vertical Single Pass Condensers**
(Film Type)

Patented ferrules give equal distribution of water to and over the surfaces of all tubes in a unit.

Battery of eight 42"x 16'-0" Vertical, Single Pass, Condensers at Armour and Company, National Stockyards, Illinois.

## HORIZONTAL and VERTICAL TYPES SHELL and TUBE CONDENSERS For Every Service

*Write For Bulletin RC-1*

**HENRY VOGT MACHINE COMPANY**
INCORPORATED
1000 W. ORMSBY ST., LOUISVILLE 10, KY., U.S.A.
Branch Offices: NEW YORK, CHICAGO, CLEVELAND, DALLAS, PHILADELPHIA, ST. LOUIS, CHARLESTON, W. VA.

# Vogt REFRIGERATION CONDENSERS